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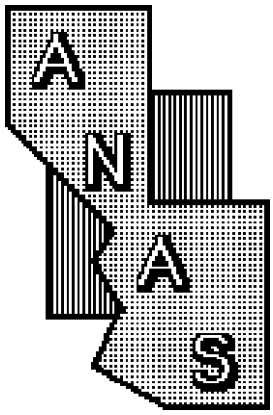

FIFTY FIRST ANNUAL MEETING

March 31, 2007

Northern Arizona University
Flagstaff, Arizona
2006-2007 Annual Reports

Proceedings
of the 51st Annual Meeting
of the

ARIZONA-NEVADA ACADEMY OF SCIENCES

March 31, 2007
Northern Arizona University
Flagstaff, Arizona

Table of Contents

ABBREVIATED SCHEDULE AND ACTIVITY LOCATIONS..... 2
SUMMARY OF SECTION MEETINGS 3
SPONSORS 4
LUNCHEON SPEAKER..... 5
BIOLOGY SECTION 6
CHEMISTRY SECTION..... 11
GEOGRAPHY SESSION 23
GEOLOGY SECTION..... 28
HYDROLOGY SECTION..... 34
MATHEMATICS/PSYCHOLOGY/SCIENCE EDUCATION SECTION 42
POSTER SESSION..... 45
ACADEMY BUSINESS AND ANNUAL REPORTS..... 51
PRESIDENT'S REPORT..... 53
MEMBERSHIP SECRETARY'S REPORT 54
NECROLOGY REPORT..... 54
PERMANENT SECRETARY'S REPORT 54
OUTSTANDING SERVICE AWARD COMMITTEE..... 55
OUTSTANDING TEACHER AWARD 55
GRANTS-IN-AID COMMITTEE'S REPORT..... 56
SCIENCE BOWL/SCIENCE OLYMPIAD LIAISON'S REPORT 56
TREASURER'S REPORT..... 58

ABBREVIATED SCHEDULE AND ACTIVITY LOCATIONS

Friday, March 30

Board meeting and dinner 5:30 – 8:00 pm
Du Bois Conference Center

Saturday, March 31

All section meetings on Saturday, March 31 will take place on the campus of the Northern Arizona University, Flagstaff, AZ

7:00 - 8:30 Registration: Foyer, Southwest Forest Science Complex

8:00 - 10:00 Paper Sessions (See Section Schedules)

10:00 - 10:30 Coffee Break and Poster Session: Foyer

10:30 - 11:30 Paper Sessions (See Section Schedules)

11:30 - 1:40 Annual Awards Luncheon: Peaks room at du Bois Conference Center

1:45 - 3:00 Paper Sessions (See Section Schedules)

3:00 - 3:30 Coffee Break: Foyer

3:30 - 5:00 Paper Sessions (See Section Schedules)

SUMMARY OF SECTION MEETINGS

Section	Session	Time	Room
Biology	**I**	**8:00**	**133**
Chemistry	**I**	**8:00**	**18**
	II	**1:45**	
Geography	**I**	**8:00**	**134**
Geology	**I**	**8:00**	**135**
Hydrology	**I**	**8:00**	**17**
	II	**1:45**	
Mathematics/ Psychology/ Science Education	**I**	**8:30**	**34**
Poster Session		**10:00**	**Foyer**

All rooms are in the Southwest Forest Science Complex in the School of Forestry

SPONSORS

The Academy would like to thank the following sponsors for their generosity in supporting the annual meeting in Flagstaff this year.

College of Engineering and Natural Sciences
Major sponsor for meeting luncheon

School of Forestry
Meeting space, equipment and luncheon sponsor

Office of Vice Provost for Academic Affairs and Dean of Graduate Studies
Sponsor of morning continental breakfast and coffee break beverages and snacks

College of Social and Behavioral Sciences
Sponsor of student volunteer registration fees

Watershed and Riparian Ecosystems of Forests and Woodlands in the Semi-Arid West Project RMRS-4302
Rocky Mountain Research Station

LUNCHEON SPEAKER

Dr. Elizabeth Grobsmith

Dr. Elizabeth Grobsmith has been the provost and vice president for Academic Affairs at Northern Arizona University since she came here in 2002. She enjoys and celebrates a long and very successful career in administration, the classroom and research. She began her career in higher education at the University of Nebraska-Lincoln in 1971 as an instructor in the Department of Anthropology. By 1991 she was promoted to full professor. She also served at UN-L as assistant dean in the College of Arts and Sciences, assistant vice chancellor for Academic Affairs, director of Summer Sessions and associate vice chancellor for Academic Affairs.

Dr. Grobsmith is the author of Indians in Prison: A Study of Incarcerated Native Americans, which was selected for the CHOICE, 1994 Outstanding Academic Award. She also is the author of Lakota of the Rosebud: A Contemporary Ethnography and numerous journal articles, book chapters and book reviews. Dr. Grobsmith earned a bachelor's degree in music from The Ohio State University and master's and doctoral degrees in anthropology from the University of Arizona. Her background as an anthropologist with a special emphasis on American Indian culture is a particularly good fit with NAU's commitment to serving Native Americans and Hispanic populations in the state of Arizona.

BIOLOGY SECTION

SESSION I 8:00

ROOM: 133

Chairperson: Robert Bowker

8:00 – 8:20 TAMARISK FLOWERING AND SEED RELEASE PHENOLOGY IN RELATION TO COLORADO RIVER HYDROGRAPHY AND CLIMATE, SOUTHWESTERN USA

Lawrence E. Stevens and Gibney Siemion (Grand Canyon Wildlands Council, Inc., Flagstaff, AZ)

Non-native tamarisk (*Tamarix spp.*) colonized riparian habitats and reservoir shorelines throughout the western United States during the 20th Century; To improve understanding of tamarisk life history, we compiled elevation, date, and reproductive phenology data from 609 tamarisk specimens in southwestern herbaria and observations in Grand Canyon from 1984-2006. We related tamarisk reproductive phenology across elevation to hydrography and flow management in the Colorado River basin. We calculated the percentage of specimens releasing seed as a function of elevation and Julian day in three elevation belts: low (300-600 m), middle (1200-1500 m), and high (1800-2100 m). We compared recruitment responses in the pre- and post-dam Colorado River mainstream, Lake Mead and Lake Powell reservoirs, and in tributaries with low- or high-elevation headwaters. Flooding timed with seed release may result in tamarisk germination events. Conversely, planned floods that specifically avoid the May-June peak tamarisk seed release period permit little tamarisk recruitment. Failing recruitment in the post-dam Colorado River in Grand Canyon has occurred because the spring-summer hydrograph is generally unsuitable for tamarisk seedling establishment. Hydrograph management may result in reduced tamarisk recruitment, while poorly-timed planned floods, simulated natural flow regimes, and unregulated tributary flows may promote tamarisk ecesis.

8:20 – 8:40 *BIOACTIVITY OF MEXICAN-AMERICAN HERBAL PRODUCTS

Hoang Huynh, Saif Binna, Pedro Chavez and William Perry Baker (Midwestern University, Glendale, AZ)

This study investigated the antimicrobial properties of representative herbal products used by the Mexican-American community. These herbs are of interest since they have been used for generations as general tonics and over-the-counter medications to treat various conditions or diseases. To assess the antimicrobial properties, we performed and replicated bioactivity

assays of 150 herbal products using the standard agar disk diffusion bioassay. The goal was to evaluate the efficacy of these plant products as potential antimicrobial agents. To this end, methanol extracts of the herbs were prepared and tested against both Gram positive (*Bacillus subtilis*, *Micrococcus luteus*, and *Staphylococcus aureus*) and Gram negative (*E. coli* and *Pseudomonas aeruginosa*) bacteria. Previous data with these herbal products resulted in 14 plants being active out of the 151 plants tested. The present replication study serves as a time-stability study to validate our procedures and as the basis for further research on the herbs. Implications of these results for bioactivity and the drug discovery potential of herbal products are discussed.

8:40 – 9:00 *PSEUDALLESCHERIA* MADUROMYCOSIS: A CASE STUDY FROM GUATEMALA WITH SPECIAL REFERENCE TO THE PHYLLOGENETIC EVALUATION OF THE GENUS

Lauritz A Jensen, Frank M Bertone, and Caroline R Lefevure (Midwestern University, Glendale, AZ)

During a medical mission to the southwestern region of Guatemala, a 65-yr-old man presented with an elephantoid condition of his right ankle and foot. The epidermis was leathery to the touch and featured numerous white granulomatous lesions—most lesions with a noticeable central sinus. Applying pressure to the lesions resulted in secretion of white grainy exudate, often followed by copious amounts of serious fluid. Punch biopsy revealed fungal elements consistent with maduromycosis, a rare but emerging disease in Latin America. Furthermore, Sabouraud's agar produced a white floccose mold that was distinguished with rope-like collections of septate hyphae, single truncate conidia on short conidiophores, and cleistothecia with ellipsoidal ascospores. These morphological attributes are consistent with *Pseudallescheria boydii* sensu lato; however, genotypic evaluation of our species showed slight variations with reference strains. Findings may indicate that *Pseudallescheria boydii* is a complex of organisms rather than a single species causative agent. The phyllogenetic relationship of *Pseudallescheria* strains will be discussed.

9:00 – 9:20 THE IMPACT OF PINYON MORTALITY ON GROUND-DWELLING ARTHROPODS

Robert Cronland, Robert Delph, and Neil Cobb (Northern Arizona University, Flagstaff, AZ)

The purpose of this study was to document the impacts of drought induced pinyon pine (*Pinus edulis*) mortality on ground-dwelling arthropod dynamics of the Middle Rio Grande Basin in New Mexico. Our major objective of monitoring ground-dwelling arthropods were to determine if there were any differences in species composition and abundance of ground dwelling-arthropods associated with environments experiencing high or low pinyon mortality. Pitfall traps were used to quantify ground-dwelling arthropod dynamics in response to pinyon die-off. This tested the hypothesis that with the die-off of a co-dominant

tree species, arthropod abundance, species richness, and dynamics changed. Due to the increased complexity of micro-habitats from fallen debris, ground-dwelling arthropod abundance and species richness will increase. Analysis of arthropod abundance and species richness between high and low pinyon mortality environments showed no significant differences, however 25% of the individual taxa analyzed were indicators of high or low pinyon mortality. Experimental pitfall plots were set up to quantify the affects of fallen woody debris on ground-dwelling arthropod dynamics. Analysis showed that arthropod abundance was higher in areas with woody debris. By understanding how ground-dwelling arthropods are affected by drought we can better understand and predict how they will respond to global climate change.

9:20-9:40 HERPETOFAUNA RESPONSE TO PONDEROSA PINE FOREST TREATMENTS - PRELIMINARY RESULTS FROM THE NATIONAL FIRE AND FIRE SURROGATE STUDY

Jean Block and Kiisa Nishikawa (Northern Arizona University, Flagstaff, AZ)

In collaboration with the United States Department of Interior's National Fire and Fire Surrogate Study, herpetofauna was sampled at the Southwest Plateau study site in Flagstaff, Arizona. The site consisted of 3 replicated forest blocks, each of which had 4 different treatment regimes: 1) an untreated area, 2) a burned area, 3) a thinned area, and 4) a thinned and burned area. Coverboards and time-constrained searches were used to sample herpetofuana. Species richness, abundance, sex ratios and adult/juvenile ratios were compared between replicated blocks and treatment regimes. The purpose of these measurements was to assess which treatment regime corresponded to greater herpetofaunal richness, abundance and reproductive success. Analysis of variance of richness, abundance, sex ratios and adult/juvenile ratios between treatment regimes suggested that there was no significant treatment effect. However, there was a significant difference in abundance between replicated blocks, with one block showing greater abundance across all treatments.

9:40 – 10:00 BIRD SPECIES DIVERSITY IN PONDEROSA PINE AND PINYON JUNIPER HABITATS IN FLAGSTAFF, ARIZONA

Tabitha M. Finch (Department of Biological Sciences, Northern Arizona University, Flagstaff, AZ)

Different habitats provide vital resources for varying numbers and types of bird species. Season also affects species diversity, richness, and abundance for a particular area. To test if these factors independently or collectively impact bird species diversity, richness, or abundance, I conducted bird censuses at six Ponderosa Pine (*Pinus ponderosa*) and Pinyon Juniper (*Pinus edulis* and *Juniperus monosperma*) sites in Flagstaff, Arizona. These two habitats vary greatly in foliage composition, and exist in close proximity in northern Arizona.

During two seasons (February/March and April/May) I collected data nine times per site using the point count method. Once the data were compiled, I used ANOVA to analyze for the statistical significance of habitat, season, and the interaction between the two on bird species diversity, richness, and abundance. I found that bird species diversity was significantly affected by the habitat and month, but was not influenced by the interaction of these variables. Results for avian richness were not significant for the habitat or habitat/season interaction, but were highly significant for the month that the census was conducted. Finally, abundance was not statistically impacted by any of these factors. Behavioral and social dynamics, such as migration and mixed flocks, may help explain why season influenced species diversity and richness. Another possibility may be that only a minimal number of bird species can withstand the harsh winter environment. The results for abundance may be explained by the concept that each habitat only provides a finite number of niches in which birds can live, regardless of the season. This study shows that although distinct habitats are present in close proximity, each supports their own unique avian community.

10:00 – 10:30 COFFEE BREAK: FOYER

10:30 – 10:50*FUEL REDUCTION ALTERS SOIL PROPERTIES, ARBUSCULAR MYCORRHIZAL FUNGI AND UNDERSTORY PLANT COMMUNITIES

Neal, Suzanne[1], Carolyn Hull Sieg[2] and Catherine Gehring[3] ([1]and [3] Northern Arizona University, Flagstaff, AZ) ([2] USDA Forest Service Rocky Mountain Research Station, Flagstaff, AZ)

Forest management practices designed to reduce fire risk, particularly thinning followed by burning slash piles, can cause below ground disturbance that creates favorable conditions for invasive plant species. Newer fuel-reduction methods, such as mechanical mastication are being examined. we measured soil properties (both physical and chemical), arbuscular mycorrhizal fungal (amf) response, and plant community composition in replicated plots of pinyon-juniper (*Pinus edulis-juniperus osteosperma*) woodland six months after being exposed to mechanical mastication, pile burning or left unmanaged as controls. Pile burns have the highest exotic to native plant ratio; higher soil temperatures, pH and concentrations of NO^{-3} and NH^{4+}; lower soil stability, soil moisture, extra-matrical hyphal density and amf spore richness and a different amf community make-up when compared to untreated areas. Two soil properties (temperature and moisture) were significantly different between mechanical mastication and untreated areas. Overall, mechanical mastication had lower impacts on belowground and aboveground communities compared to slash pile burning and therefore may be a preferable method for fuel reduction.

11:30 – 1:40 LUNCHEON: PEAKS ROOM IN DU BOIS CONFERENCE CENTER

CHEMISTRY SECTION

SESSION I **8:00**

ROOM: **18**

Chairperson: Timothy Vail

8:00 – 8:15 *USING FLUORESCENCE TO PROBE THE STRUCTURAL STATE OF P27KIP1, AN INTRINSICALLY DISORDERED PROTEIN

Trenton Baker, LaBrittney Williams, Matthew J. Gage (Northern Arizona University, Flagstaff, AZ)

Intrinsically disordered proteins (IDPs) are proteins that lack distinct secondary and tertiary structure and yet they still manage to perform essential functions inside the cell. Therefore, they represent a unique set of proteins that defy the long held structure-function paradigm. Many IDPs have been shown to form secondary structure in vitro when bound to their substrate. To date, no one has been able to demonstrate that these proteins are truly disordered inside the cell. Lumio® is a fluorescent molecule that binds to a tetra-cysteine motif. By inserting the Lumio® binding motif into the IDP p27Kip1 in a certain region of substrate associated structure (a Î²-hairpin loop), we hope to discover whether this structure is preformed or induced in vivo. If the current prevailing hypothesis is correct, when p27Kip1 is in its disordered state (absence of substrate), the cysteines will not be in close enough proximity to each other and the Lumio® probe will not bind and fluoresce. In the presence of the expressed substrate (Cyclin A and Cdk2 complex), the cysteines on the bound p27Kip1 should be in close enough proximity to bind the Lumio® probe and stimulate fluorescence. Here, we present preliminary results from protein expression and in vitro fluorescence tests. Once the viability of the system is verified in vitro, we will apply this system in vivo.

8:15 – 8:30 *THE STABILITY OF 23MER MUTANT I-MOTIF STRUCTURE

Meredith Blynn, Robert Buscaglia, and Edwin A. Lewis (Northern Arizona University, Flagstaff, AZ)

This study explores the structural stability of a mutant construct of the i-motif formed in the promoter of the c-MYC oncogene. The 23mer mutant i-Motif was investigated using Circular Dichroism (CD) and Differential Scanning Calorimetry (DSC) techniques to explore the thermal stability of the structure. These investigations have been performed in a variety of solution conditions (varying $[K^+]$ and pH). CD and DSC investigations demonstrated that the i-motif construct attains maximum stability at a pH between 4.0 and 5.0. The CD investigations distinctly showed three different signatures at pH 7.0, 5.0, and 2.5. The

signature identified at pH 7.0 was not clearly a classical i-motif structure. This non-classical signature remained unchanged as the concentration of potassium was varied. Using water instead of a buffering solution showed a single, stable conformation. This conformation appears to be stable between pH 5.0 and 4.0 but due to freeze drying of the DNA samples additional substances are included in the solution that affected the pH of the DNA solution. Due to these additional substances, dissolving the DNA in water resulted in an acidic solution. Therefore, water is not an efficient solvent for these studies, due to a lack of buffering capacity.

8:30 – 8:45 *COMPUTATIONAL MODELING IN SEARCH OF I-MOTIF SELECTIVE COMPOUNDS

Jamie Dettler, Derek Cashman, Matthew W. Freyer, and Edwin A. Lewis
(Northern Arizona University, Flagstaff, AZ)

Targeting specific DNA sequences has become an important area of anti-cancer research. In the human body there are many instances of simple repetitive DNA sequences, such as in telomeres, that are composed of guanine-rich and cytosine-rich strands that under certain conditions can adopt higher order structures known as G-quadruplex and i-Motif. There have been numerous studies involving the binding of small molecule compounds specifically to G-quadruplex DNA but minimal research has been performed on binding small molecule compounds to its complimentary i-Motif strand. Stabilization of the i-Motif may lead to down-regulation of oncogenes and is a promising target for anticancer drug design. We have studied the interactions of multiple low molecular weight compounds with c-MYC i-Motif using Insight II molecular modeling program. Using Insight II Affinity and Discovery module we have shown favorable binding of these compounds to the i-Motif. Quinacrine and 3-aminofluruoranthene were two compounds that showed positive binding results and were commercially available. Their true binding capabilities were evaluated further using Isothermal Titration Calorimetry (ITC). These compounds provide promising lead structures for developing anticancer drugs in the future.

8:45 – 9:00 *DESIGN AND IMPLEMENTATION OF A FIELD RESEARCH PROJECT FOR UNDERGRADUATES

Beatriz Estrada and Jani C. Ingram (Northern Arizona University, Flagstaff, AZ)

The objective of my project is to design field experiments/research for a group of 3-5 undergraduates in which we will conduct in Silverton, Colorado. The project will take place through the Geography Contemporary Development 599 course in February 2007. Undergraduate students assigned to me will collect water samples from various locations of the peaks. The locations will be chosen upon arrival based on what we have access to on our trip. When we return from our trip, undergraduates will solve for concentrations of metals using a variety of instruments, such as Global Positioning System (GPS) unit, pH, turbidity, and conductivity. I will have a set procedure for students to follow during our research trip to Silverton, CO so we can accomplish our goals. Concentrations found will be recorded and reported to compare water samples from various locations of the San Francisco Peaks. The

information found in our research will help the residents of Silverton understand the problems & concerns they are facing. Silverton sits at an elevation of about 9,000 feet peaks of the San Juan Mountains. Unlike most mountain towns, the only way out by road is over passes because the town is located in an enclosed valley, which is a volcanic caldera. The town is small and poor compared Telluride, Crested Butte and other mining-turned-ski towns. Silverton has small ski areas, maintaining its mining tradition. The mines (Standard Metals, the Idarado) are either shut down or under reclamation.

9:00 – 9:15 *TOXICITY OF URANYL ACETATE ON P53 IN ALTR CELL LINES

Ellie Heintze and Matthew J. Gage (Northern Arizona University, Flagstaff, AZ)

Cancer is the second leading cause of death in the United States, and there is a growing interest in the relationship between the heavy metal effects of uranium and cancer. It is known that uranium causes DNA breaks not through radiation but because it is a heavy metal. The protein p53, a tumor suppressing protein, has shown to initiate DNA repair and initiate apoptosis. While uranyl acetate induces DNA damages it is not clear if p53 is upregulated by uranium exposure. The ability of uranyl acetate to induce p53 upregulation in vivo is being studied. A rat cell line is used that expresses a temperature sensitive form of p53 (A1-5) and a series of cell lines derived from the A1-5 cell line. The derived cell lines contain mutations that inhibit nuclear localization of p53. Uranyl acetate toxicity and the ability of uranyl acetate to upregulate p53 are being measured for these cell lines. This research will increase the understanding of how cells protect themselves from uranium damage.

9:15 - 9:30 *CALORIMETRIC AND SPECTROSCOPIC EVIDENCE FOR THE BINDING OF TMPYP4 TO A 23MER C-MYC I-MOTIF MUTANT

Vu Le, Robert Buscaglia, Derek J. Cashman, Matthew W. Freyer, and Edwin A. Lewis (Northern Arizona University, Flagstaff, AZ)

The binding of the cationic porphyrin, TMPyP4, to the i-motif-forming 23 base deoxyoligonucleotide derived from the c-MYC P1 promoter sequence was investigated. Interaction of TMPyP4 and the 23-mer as a function of ionic strength, cation, pH and temperature were analyzed by Isothermal Titration Calorimetry (ITC). ITC data suggests that binding is relatively independent of ionic strength, the presence of cations, temperature, but strongly dependent on pH. TMPyP4 binding to i-motif DNA has an affinity of approximately 106 M-1, and is only slightly weaker than binding of the same compound to the complimentary G-quadruplex. Spectroscopic results show that every mole of oligonucleotide is bound with two moles of TMPyP4, and that the binding is best modeled by an exterior stacking mechanism. TMPyP4 increases the stability of the i-motif. The exterior stacking nature of the binding and stoichiometry are consistent with computations. Drug stabilization of i-motif structures demonstrates good potential for oncogene regulation. The study of drug

interactions with DNA constructs containing both looped out i-motif and quadruplex features (e.g. a model for the c-MYC NHE-III1), is an area of future investigation.

9:30 – 9:45 *DETECTION OF DNA-DNA CROSSLINKS IN CHINESE HAMSTER OVARY CELLS: OPTIMIZATION OF A PROTOCOL

Julia A. Mackey, Virginia H. Coryell, and Diane M. Stearns (Northern Arizona University, Flagstaff, AZ)

Hexavalent chromium, Cr(VI), is a recognized carcinogen but exactly how this metal causes cancer remains a mystery. It has been proposed that DNA-DNA cross-links are one of the lesions induced by Cr(VI) but it is unknown whether these cross-links result in cell death or if they are causing mutations that could lead to cancer. In order to investigate this, a protocol to detect cross-links in Chinese hamster ovarian (CHO) cells was developed based on fluorescent measurements of double stranded DNA. Our hypothesis is that if an agent causes cross-links in DNA then that DNA will remain double stranded despite exposure to high heat. We will be able to detect these cross-links using a fluorescent dye that binds exclusively to double stranded DNA. If that agent does not cause cross-links then all of the DNA will denature and become single stranded at high temperatures and we will see less fluorescence from the dye. This protocol will then be applied to CHO cells treated with Cr(VI) to determine if this metal is inducing cross-links. It will also be applied to CHO cells that have been treated with Cr(VI) and allowed to recover to see if the cells still contain cross-links or if the lesions must be repaired in order for the cell to survive. This work is supported by a Beckman Undergraduate Research Award.

9:45 – 10:00 *CYTOTOXICITY OF COMBINED EXPOSURES OF URANYL ACETATE AND SODIUM ARSENITE IN CHO CELLS

Sheryl L. Martinez, R. Clark Lantz, and Diane M. Stearns (Northern Arizona University, Flagstaff, AZ; University of Arizona, Tucson, AZ)

High concentrations of uranium contaminate water sources in the Colorado plateau, the West Central Platform, and the Rocky Mountains. Arsenic levels have also been shown to be high in areas of uranium mining and processing, which are common in the Southwestern United States. This creates a potential for human co-exposures to arsenic and uranium. Previous work from our labs has shown that uranium(VI) as uranyl acetate (UA) caused DNA strand breaks, U-DNA adducts and *hprt* mutations in Chinese hamster ovary (CHO) cells. Others have shown that arsenic(III) can inhibit DNA repair, affect signal transduction, and induce oxidative stress and apoptosis. Our current working hypothesis is that if UA causes DNA damage and As(III) inhibits DNA repair or induces oxidative stress, then combinations of uranium and As(III) could be more toxic than either metal alone. This hypothesis is being tested by exposing CHO cells to combinations of UA and sodium arsenite together or at different times and then measuring cytotoxicity through colony forming ability. Current results suggest that co-treatments of UA and As(III) are more toxic than individual

exposures. Results from these studies could ultimately contribute to the interpretation of epidemiological studies in populations exposed to uranium by identifying confounding variables of human exposures. Supported by the NAU Minority Student Development program (NIH #GM56931), and the Native American Cancer Research Partnership (NIH # CA96302).

10:00 – 10:30 **COFFEE BREAK: FOYER**

10:30 – 10:45 *INFLUENCE OF DUPLEX TAIL REGIONS ON C-MYC QUADRUPLEX CONFORMATION: BINDING AND STABILITY

Susan McClelland, Robert Buscaglia, Matthew W. Freyer, and Edwin A. Lewis (Northern Arizona University, Flagstaff, AZ)

The stabilization of G-quadruplex and i-motif structures of DNA offers a possible means of anti-cancer therapy. Of particular interest is the stability of G-quadruplex and i-motif structures in the c-MYC oncogene. c-MYC is a transcription factor for the catalytic domain of the telomerase enzyme. This study investigates the influence of duplex tail regions on c-MYC quadruplex conformation, binding, and stability. The study made use of multiple oligonucleotide constructs which included: a 36-mer single stranded model of the native quadruplex, a 36-mer single stranded mutant that forms only the 1:6:1 loop isomer of the c-MYC quadruplex, and several double stranded constructs that model the duplex regions adjacent to the quadruplex but lack the i-motif forming sequence. These studies demonstrated that the native quadruplex sequence forms at least two distinct melting conformers. The mutant 1:6:1 looped out structure exhibits a single melting profile that matches the lower temperature melting conformer present in the native 36mer melting profile. The higher melting conformer (presumable the 1:2:1 loop isomer) is present at higher proportion in the single stranded construct, but increases in proportion as the tails are tied up in duplex DNA in the double stranded construct. Future studies will investigate drug binding to oligonucleotide constructs that model the 1:6:1 and 1:2:1 looped out structures.

10:45 – 11:00 *CHROMIUM(VI) GENOTOXICITY ANALYSIS USING THE COMET ASSAY

Annette R. Pusher, and Diane M. Stearns (Northern Arizona University, Flagstaff, AZ)

Hexavalent chromium (Cr(VI)) is used in chrome plating, paint and dye manufacturing, and leather tanning. Cr(VI) is also a known human lung carcinogen. Inside the cell Cr(VI) is reduced through intermediate oxidation states and free radicals to produce Cr(III), and a range of DNA lesions are formed; however, it is not understood which DNA lesions are mutagenic, which may contribute to tumor formation, or which lesions are cytotoxic, which would lead to cell death. The goal of this work is to use the single cell gel electrophoresis assay (SCGE, or the comet assay) to detect the relative amounts of DNA lesions formed in a series of Chinese hamster ovary (CHO) cells deficient in different steps of DNA repair. Initial studies on the repair proficient CHO AA8 line have been completed. CHO AA8 cells

were exposed to potassium dichromate at 10 - 40 µM Cr(VI) for 24 hr. Hydrogen peroxide at 40 µM was used as a positive control, and untreated cells served as a negative control. The tail moments decreased with increasing dose of Cr(VI), suggesting that DNA-DNA crosslinks were the major form of DNA damage. Future studies will characterize mutation spectra for Cr(VI) in this line to determine if mutations are consistent with the generation of DNA-DNA crosslinks. Supported by the NAU Minority Student Development program (NIH #GM56931).

11:00 – 11:15 *THE ROLE OF WATER IN LIGAND-DNA BINDING: OSMOTIC STRESS EXPERIMENTS USING ISOTHERMAL TITRATION CALORIMETRY AND DIFFERENTIAL SCANNING CALORIMETRY

Joseph P. Ramos, Matthew W. Freyer, Robert Buscaglia, and Edwin A. Lewis (Northern Arizona University, Flagstaff, AZ)

Water is known to play an intricate role in DNA structure and formation. Presently, the role of water is also thought to play a role in Ligand-DNA binding. The purpose of this study was to determine the role water has in the formation of a complex containing duplex DNA and a known minor groove binding ligand, Netropsin. Thermodymanic properties of this complex were obtained using Isothermal Titration Calorimetry (ITC) and Differential Scanning Calorimetry (DSC). Two different osmolytes were introduced into the solution environment to reduce the activity of the water, thus probing the impact of water on complex formation. Analysis of the experimental data indicate two different binding modes of the ligand to duplex DNA, one which there is direct bonding between the ligand and DNA and another where water is facilitating the interaction through hydrogen bonding in a bridge type manner.

11:15 – 11:30*ANALYSIS OF PARTICULATE URANIUM UPTAKE IN CELLS BY TRANSMISSION ELECTRON MICROSCOPY

Michelle R. Romanotto, Virginia H. Coryell, Marilee A. Sellers, and Diane M. Stearns (Northern Arizona University, Flagstaff, AZ)

People can be exposed to uranium through mining and the use of depleted uranium in military munitions and tank armor. Uranium(VI), as uranyl ion, has long been acknowledged for both its chemical and radiological toxicity. Uranium can enter the body through ingestion, inhalation, or contamination of wounds. Previous toxicity studies have focused on water-soluble uranyl salts rather than on insoluble uranium particulates. However, uranium(VI), (V), and (IV) particulates better model the speciation of uranium found in soil and burned depleted uranium metal. The purpose of this work is to understand how particulate uranium affects the body on a cellular level and how exposures may cause genetic mutations. Chinese hamster ovary (CHO) AA8 cells were exposed to three forms of particulate uranium: uranium(VI) trioxide, UO_3, uranium(IV) dioxide, UO_2, and the mixed triuranium octaoxide, U_3O_8. Cells were then fixed and embedded in resin for examination by

transmission electron microscopy (TEM). Preliminary observations have shown that these uranium particulates do become internalized within cells, but further investigation is needed to determine which cellular structures are most affected. Supported by the NAU Native American Cancer Research Partnership, NIH #CA96302.

11:30 – 1:40 LUNCHEON: PEAKS ROOM IN DU BOIS CONFERENCE CENTER

1:45 – 2:00 *THE EFFECTS OF URANYL NITRATE ON DNA IN THE PRESENCE OF SODIUM ASCORBATE AND SODIUM CITRATE

Aaron M. Whittaker, Virginia H. Coryell, Christopher J. Kuehl, and Diane M. Stearns (Northern Arizona University, Flagstaff, AZ)

Uranium is mined and used in the production of nuclear energy and warfare. Naturally occurring uranium undergoes radioactive decay to produce alpha and beta particles that have been linked to lung cancer in miners. Depleted uranium, which is less radioactive than natural uranium, also produces DNA damage and mutations in cells; however, its health effects in people are poorly understood. The purpose of the current experiments was to determine the effects of coordinating ligands on DNA damage caused by depleted uranium in the form of uranyl nitrate. The ligands tested were sodium ascorbate and sodium citrate. It was hypothesized that if multidentate ligands fully coordinate with uranyl ion, then its reactivity with DNA may be inhibited. This hypothesis was tested by exposing supercoiled pBluescript plasmid DNA to uranyl nitrate and organic ligands, and analyzing the generation of DNA single strand breaks with gel electrophoresis. Results have shown that the reaction of sodium ascorbate with uranyl nitrate increased DNA strand breaks relative to uranium alone, but reactions of sodium citrate and uranyl nitrate decreased DNA strand breaks. These results, combined with spectroscopic analysis, suggested that complex formation between uranyl ion and citrate prevented uranyl ion from associating with DNA. Thus the coordination environment of uranyl ion will influence its genotoxicity. Supported by an NAU Hooper Undergraduate Research Award.

2:00 – 2:15 *EXPLORING THE INTERACTIONS OF A C-MYC MODEL QUADRUPLEX WITH TMPYP4 USING THERMODYNAMICS AND FLUORESCENCE

Zeina Ziade, Nagesh Narayana, Matthew W. Freyer, and Edwin A. Lewis (Northern Arizona University, Flagstaff, AZ)

Cancer has been identified as the second leading cause of death in adults in the United States. It is obvious that current cancer chemotherapy is not beneficial enough to counter this threat. One of the largest problems with chemotherapy is the lack of specificity in targeting

cancer cells and leaving healthy cells unharmed. Studies have demonstrated that higher-order DNA structures called G-quadruplexes form in the promoter regions of well over half on the known oncogenes. Though these structures do form in other genes, targeting these structures may provide increased specificity for new anti-cancer therapeutics. One of these known oncogenes is c-MYC, which is directly related to telomerase and cell immortality. The purpose of this study is to explore the structure of a model of the quadruplex formed in the promoter region of c-MYC. This study initially focused on exploring the structural stability of the model quadruplex and also the thermodynamics of binding a model compound, TMPyP4 to the quadruplex. A review of these binding and structural stability studies will be presented. In addition, new studies of the interactions between quadruplex DNA and TMPyP4 using spectrofluorimetry will be discussed. Spectrofluorimetry was used to probe the exact binding order of TMPyP4 using a number of quadruplex models with 2-aminopurine mutations in the loops of the quadruplex.

2:15 – 2:30 THE COMPOSITION OF WOOD SMOKE IN PRESCRIBED FIRES

Xavier Nelson (Northern Arizona University, Flagstaff, Arizona), Marin S. Robinson (Northern Arizona University, Flagstaff, AZ), Pierre Herckes (Arizona State University, Tempe, AZ)

Prescribed fire is an effective way to reduce forest fuel loads and lower the risks of catastrophic wildfire. However, prescribed fire is also a well-known source of fine particulate matter or PM-2.5, particles with diameters <2.5 μm and small enough to reach the lungs. To better understand the composition of particulate from prescribed fire, PM-2.5 has been collected during 12 prescribed fires of the Coconino and Apache National Forests in Arizona in Fall 2003 through Fall 2006. The composition of the particulate from these fires will be summarized, including results on elemental analysis (by X-ray fluorescence spectroscopy), organic and elemental carbon analysis (by thermal optical methods), and organic composition (by gas chromatography/mass spectrometry). Results will be used to assess exposure risks to firefighters as a result of prescribed fire activities.

2:30 – 2:45 DETERMINATION OF ^{244}PU IN NUCLEAR WEAPONS TESTING FALLOUT

Brian Strick and Michael Ketterer (Northern Arizona University, Flagstaff, AZ)

The heavy isotope ^{244}Pu is relevant in cosmochemistry as a tracer of relatively continuous terrestrial deposition of interstellar matter, and from intermittent proximal supernovae events. Its main source in the cosmos is the R-process, which is the primary mechanism in Nature for formation of isotopes heavier than ^{56}Fe. Since ^{244}Pu is radioactive, and its half life (83 million years) is short compared to the Earth's age, this isotope is very useful in studies of ISM and supernovae over the past several hundred million years. However, one additional source of ^{244}Pu exists that must be thoroughly understood (and avoided) in cosmochemistry applications; namely, the presence of anthropogenic ^{244}Pu from nuclear weapons testing. During the 1950's and 1960's, atmospheric tests of nuclear weapons were conducted mainly

by the US and former Soviet Union; these tests injected plutonium, other transuranic elements, and fission products into the stratosphere. Thereafter, fallout from the stratosphere re-entered the troposphere, and was deposited throughout the Earth's surface. It is well established that this "stratospheric fallout" contains a fairly predictable distribution of plutonium isotopes, however, ^{244}Pu has not yet been adequately measured. In order to address the abundance of ^{244}Pu from stratospheric fallout, samples of surface soil from a well-suited location in Minnesota were collected and analyzed. These samples contain relatively high activities of stratospheric fallout Pu based upon annual precipitation and features of the terrain. Plutonium was leached from 100 gram sample aliquots with nitric acid, isolated and purified using a solid-phase ion-pairing polymeric resin, and Pu atom ratios were subsequently measured using inductively coupled plasma mass spectrometry (ICPMS). Plutonium atom ratios were compared with other previously published data (Kelley *et al*., 1999). Our measured Pu atom ratios were as follows: ^{240}Pu/^{239}Pu = 0.192 ± 0.004; ^{241}Pu/^{239}Pu = 0.00171 ± 0.00005; ^{2}Pu/^{239}Pu = 0.0043 ± 0.0003, and ^{244}Pu/^{239}Pu = 0.00013 ± 0.00001. The first three ratios agree well with the findings of Kelley *et al*. The ^{244}Pu/^{239}Pu ratio has been measured for the first time in "stratospheric fallout"; a value of 0.00013 ± 0.00001 (1σ) has been determined. The relative abundances of ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, and ^{244}Pu agree with a successive fast neutron retention capture model proposed by Diamond *et al*. (1960). Further work is being conducted to better define the abundance of ^{244}Pu from "stratospheric fallout" as well as other anthropogenic Pu sources.

2:45 – 3:00 DEVELOPMENT OF A NOVEL TECHNIQUE TO MONITOR PROTEIN_PROTEIN INTERACTIONS *IN VIVO*

Tawnya Webber and Matthew Gage (Northern Arizona University, Flagstaff, AZ)

Protein-protein interactions play a critical role in all cellular processes; however, there are limited methods for monitoring these interactions *in vivo*. We have been using the tetramerization domain of the tumor suppressing protein, p53, to develop a fluorescence method for monitoring domain interactions within the cell using the fluorescent probe Lumio™. Lumio™ fluoresces when it binds to its target tetracystine motif; however, unbound Lumio™ does not fluoresce. We have incorporated the Lumio™ binding motif along the tetramerization interface of p53 in order to develop a novel technique to measure protein-protein interactions. Initial fluorescence studies indicate strong binding of Lumio™ to the modified tetramerization domain. This binding is eliminated by the introduction of the L344A mutation. This mutation occurs at the dimer-dimer interface of the tetramerization domain and prevents two dimers from combining to form a p53 tetramer. The decrease in binding within the 344-containing mutant demonstrates the lack of a binding site for Lumio™ in the dimeric form of the protein, validating our system. Further characterization of the system is ongoing.

3:00 – 3:15 POSSIBLE ENVIRONMENTAL EXPOSURES OF URANIUM FROM SHEEP

Lydia A. Edgewater and Jani C. Ingram (Northern Arizona University, Flagstaff, AZ)

During the 1940's to the 1970's, uranium mining took place on the Navajo Reservation, resulting in hundreds of abandoned mines and areas of mine waste. The issue with past mine activities continues to be a problem for the people who live near the abandoned mines on the Navajo Reservation. A suspected pathway of uranium exposure to the Navajo is through their food supply, specifically from mutton, a traditional food eaten by the Navajo people. In the Summer of 2006, we worked with a Navajo family who provided our research group with aged sheep which had grazed on the abandoned mines near Cameron, AZ for most of its life. We are working with this family to analyze the organs and tissues of the sheep to determine if uranium accumulation is present. A focus of the recent work on this project has been to develop extraction procedures for uranium analysis. These extracts are then analyzed for elemental uranium using inductively coupled plasma mass spectrometry. The information learned from these studies will be reported back to the affected Chapters. Finally, we recently have been in contact with a family living in the Cameron Chapter who are raising sheep that graze on and around the uranium mines.

3:15 – 3:30 DEVELOPING NEW MOLECULAR TARGETS FOR ANTI-PANCREATIC CANCER CHEMOTHERAPEUTICS: TARGETING THE COMPLETE SILENCER ELEMENT IN THE K-RAS ONCOGENE

Matthew W. Freyer and Edwin A. Lewis (Northern Arizona University, Flagstaff, AZ)

Pancreatic Cancer is the 5th leading cause of cancer death in the United States. In 2006 there were 33,730 new diagnoses of pancreatic cancer, and 32,300 deaths resulting from pancreatic cancer. Currently anti-pancreatic cancer therapeutics are vastly inadequate, producing a number of devastating side effects with little therapeutic benefit. Developing new molecular targets for pancreatic cancer is difficult as the development of pancreatic cancer is genetically complex. One common thread in pancreatic cancer, is that the K-ras proto-oncogene is overexpressed in greater than 90% of pancreatic tumors. This oncogene contains a sequence in its promoter region that can form a complete silencer element consisting of a quadruplex and an i-motif structure. Because G-quadruplex and i-motif forming sequences have been identified in the promoter regions of 40% of human genes, simply targeting these structures is not enough to specifically target cancer. A more elegant approach involves targeting the unique topology created when G-quadruplex and i-motif structures form in tandem. The purpose of this study is to explore the structural stability of the K-ras complete silencer element, as well as to predict possible small molecules or DNA binding aptamers that will stabilize the K-ras silencer element structure.

3:30 – 3:45 MODELING ITC THERMOGRAMS BY MULTIPLE INDEPENDENT BINDING PROCESSES AND MONTE CARLO ANALYSIS

Buscaglia, R., Lewis, E. A.(Northern Arizona University, Flagstaff, AZ)

Isothermal titration calorimetry thermograms contain invaluable thermodynamic information including Gibbs free energy changes, enthalpy changes, and total binding stoichiometries. These thermodynamic parameters can be further deconvoluted into entropic and enthalpic contributions resulting in possible mechanisms behind binding interactions. However, with the quickly evolving sciences of biophysics and biochemistry, the ability to accurately model and interpret these thermograms is beginning to lag behind the data being obtained from ITC experimentation. That is, without the ability to model highly complex ITC thermograms, the potentially invaluable information can not be utilized. Presented here are nonlinear regression algorithms developed in MathematicaÂ© with applications for modeling multiple independent binding processes. Included is a closed form solution for n-independent binding processes, as well as Monte Carlo analysis of the algorithms giving statistical validity of best-fit parameters obtained. Simulated data for several independent binding processes are discussed along with the complexity of accurately modeling ITC thermograms. Lastly, the nonlinear regression algorithms are applied to ITC data collected on interactions between novel anti-cancer agents and higher-order DNA structures. This application to ITC thermograms shows the diversity of problems to which these nonlinear algorithms may be applied, as well as the flexibility to model highly complex thermograms.

3:45 – 4:00 AGGREGATION PROPERTIES OF THE TUMOR SUPPRESSOR PROTEIN P53

Ashley Steiner, Jilleen Jones and Matthew J. Gage (Northern Arizona University, Flagstaff, AZ)

The p53 tumor suppressor protein is one of the most critical points of regulation in tumor prevention. The p53 protein initiates DNA repair or apoptotic pathways in response to DNA damage or other cellular stresses. It comes as no surprise then that more than 50% of all cancers are associated with a mutated form of p53. The effects of p53 aggregation due to mutation on tumor formation are largely unknown. This study will begin to characterize the aggregation propensity of the tetrameric form of p53. We have begun to look at the aggregation rate of a truncated form of the p53 protein, p53-360, which doesn't have the N- or C- terminus. We have measured aggregation rates with classical light scattering and with the fluorescent probe ThT. We also have begun to characterize the morphology of the aggregates with transmission electron microscopy

4:00 – 4:15 NON-SURGICAL ANIMAL SPAYING VIA 4-VINYLCYCLOHEXENE DIEPOXIDE

Anna Ghurbanyan, Loretta P. Mayer, and Timothy L. Vail (Northern Arizona University, Flagstaff, AZ)

Animal overpopulation is a recognized problem in the United States. The common solution to this problem is the surgical sterilization (spaying) of animals. However, surgical sterilization has associated problems – risk of infection or other surgical complications, pain, extended recovery time, high cost and labor. We are investigating non-surgical alternatives

for female dogs and cats. The non-surgical technique should target the following features – effectiveness, irreversibility, low cost, and the established loss of sexual behavior. Repeated daily dosing with 4-vinylcylclohexene diepoxide (VCD) selectively destroys pre-antral ovarian follicles (primordial and primary follicles) in mice and rats via apoptosis (ChemSpay®). It has been shown that administration of VCD via injection at 160 mg/kg for 15 days can cause follicular depletion by day 58 in both species. The resulting follicular depletion is completely irreversible. The purpose of this study was to reduce the dosage regimen to a single dosage of VCD that will cause irreversible follicular depletion. The routes of administration include oral dosage or intraperitoneal injections. Three separate experiments were conducted using polymeric nanoparticles (50 nm polystyrene, PS, at 10% solids) as drug delivery carriers. Characterization was performed by GC-MS. Future work using nanotechnology may involve biodegradable nanoparticles and cross-linked nanoparticles. Other drug delivery methods involved the use of excipients such as emulsifiers and sugars. Attempts have been made to lyophilize VCD in sugar glasses such as inulin and trehalose. Future work will include separation of the active component from a mixture of isomers.

GEOGRAPHY SESSION

SESSION I **8:00**

ROOM: **134**

Chairperson: Steven Yool

8:00 – 8:15 IMPACT OF STRUCTURAL FUNDS ON REGIONAL GROWTH: HOW TO RECONSIDER A 7 YEAR-OLD BLACK-BOX

Sandy Dall'erba Dept. of Geography and Regional Development,(University of Arizona, Tucson, AZ), Rachel Guillain (Laboratoire d'Economie et de Gestion Pôle d'Economie et de Gestion Dijon Cedex, France) and Julie Le Gallo (CRESE, Université de Franche-Comté, Besançon Cedex, France)

Econometric estimations of the impact of structural funds on the growth process of the European regions started 7 years ago. However, it is striking to realize that all previous estimations in this field are based on some form of the neoclassical growth model (Solow's model). This model is still widely used despite the numerous critics it has raised (Quah, 1996) and its lack of consideration for increasing returns to scale, which are at the heart of agglomeration and growth processes according to endogenous growth theories and new economic geography models. In addition, few estimations have paid attention to the nature of the cohesion objectives under study. For example, the expected impact of objective 1 funds, devoted to public infrastructures, is indeed theoretically and empirically very different from the one of objective 3 funds devoted to long-term unemployed. As a result, the aim of this paper is to propose a careful assessment of the impact of structural funds on the manufacturing sector of 145 European regions in the context of a Verdoorn's law for the period 1989-1999. First, the results are presented with total structural funds and funds differentiated by objective. Second, interregional linkages are included by means of spatial econometric techniques. Third, potential endogeneity of the explanatory variables is taken into account.

8:30 – 8:45 FOREIGN DIRECT INVESTMENT AND ITS AFFECTS TO THE REGIONAL RECONSTRUCTION OF TURKEY WITH AN EMPHASIS ON SOUTHEAST ANATOLIA AND MARMARA REGIONS

Ahmet Karaaslan (Dumlupinar University, Kutahya), Bulent Ozkan and Gokcen Ozkan (Gaziantep University,Gaziantep)

This paper explains how the foreign direct investments to the southeast anatolia and marmara regions affects the fundamental differences in reconstruction period of these two fundamentally different parts of the country based on the regional research data. These economical development was explained using Rostow's reconstructional period phase method, where this economical thesis focuses on the countries that are still developing and demontrates large variences depending on the geoprahical location in the country. The other examples including the (Shangie,China example) showed that regions that attracts the foreign direct investments develop faster than the others. These research works presents the details of the direct foreign investments that have been in the Turkey since 1990 according to their geographical location in the country. It will be shown that the regions that attracted more foreign investments had a big factor to reconstruct the specific region compared to the other ones.

8:45 – 9:00 EVALUATION OF NAVAJO NATION'S HYDROCLIMATE NETWORK: PRELIMINARY REPORT

Gregg Garfin (University of Arizona, Tucson, AZ) Aregai Tecle and Diana Anderson (Northern Arizona University, Flagstaff, AZ) Michael Crimmins (University of Arizona, Tucson, Az), Andrew Ellis (Arizona State University, Tempe,AZ), John Leeper (Navajo Department of Water Resources, Fort Defiance, AZ), Nancy Selover (Arizona State University, Tempe, AZ) and Jolene Tallsalt-Robertson (Navajo Department of Water Resources, Fort Defiance, AZ)

Navajo Nation, the largest Indian reservation in the United States, operates 209 hydroclimate gages through the stewardship of the Navajo Department of Water Resources (NDWR). The gage networks include stream gages, automated weather stations, snow surveys, recording and non-recording precipitation gages. The overall network is derived from a patchwork of diverse networks developed to meet specific short-term needs. Maintaining the gage network, processing data, and performing data quality control exceeds current Navajo Nation manpower capacity and expertise. However, the data from these networks are critical to Navajo Nation resource planning, and its economy – which have been severely affected by recent drought. With funding from the Arizona Water Institute, investigators from Arizona's three state universities and NDWR have embarked on a one-year project to perform a systematic analysis of the NDWR hydroclimate network. The primary goals of the project are to provide recommendations for rationalizing the network, reducing manpower requirements, and improving data collection and processing, in order to support drought and hydrologic analysis and long-term impact assessment. The project also aims to facilitate coordination between NDWR and other regional data collection efforts. This presentation will give an update on project context, challenges, and progress to date.

9:00 – 9:15 *A SYNOPTIC CLIMATOLOGY OF DESERT DUST DEPOSITION TO THE ALPINE SNOWPACK IN THE SAN JUAN MOUNTAINS, COLORADO, U.S.A

Kathleen E McBride (Northern Arizona University, Flagstaff, AZ) Thomas Painter (National Snow and Ice Data Center) and Chris Landry (Center for Snow and Avalanche Studies)

Collaborative research is underway in the San Juan Mountains to study the radiative and hydrologic effects of desert dust deposits on alpine snow. The component described here is the development of a synoptic climatology for winter and spring dust deposition to the alpine snowpack in the San Juan Mountains of southwest Colorado. The purpose of this study is to determine what types of meteorological and climatological characteristics generate the dust deposition events in the San Juan Mountains. A further understanding of the climatology of dust deposition events will provide insight into the interactions between deserts and mountains and facilitate seasonal to daily predictions of dust emission events. We analyze 18 dust deposition events that have been documented in snow in the San Juan Mountains of Colorado in winter and spring seasons of 2003 through 2006. The research explores antecedent precipitation, soil moisture, wind conditions, vegetation cover, pressure patterns at 500mb and the back trajectories of dust events and dust-free events. Data from the Southwest Climate Impact Meteorological Stations (CLIM-MET), the Geostationary Operational Environmental Satellites (GOES) and the Stochastic Time-Inverted Lagrangian Transport (STILT) model are analyzed. Finally, existing correlations between ENSO and the San Juan Mountain dust events are investigated.

9:15 – 9:30 A LACUNARITY APPROACH FOR URBAN LAND USE LAND COVER CLASSIFICATION

Soe Myint (School of Geographical Sciences, Arizona State University, Tempe, AZ)

It has been reported that dimensions do not provide a complete fractal characterization of a set's texture. Lacunarity, a new method for texture analysis, which can be used to describe the characteristic of fractals of the same dimension with different texture appearances, was examined. This study developed specialized computer programs that support the application of lacunarity algorithms. This was basically to determine if lacunarity analysis could serve as an effective technique for urban mapping using multispectral IKONOS image data. Different local moving window sizes were tested. The texture-transformed images generated by the lacunarity approaches were used to identify urban classes using maximum likelihood classification algorithm. The selected land-use and land-cover classes include single-family houses with less than 30% tree canopy, single-family houses with more than 30% tree canopy, commercial, forest, agriculture, and water body. Same training samples for all selected classes were used to classify urban classes for combination of multispectral bands and/or texture-transformed images. In general, the overall accuracy increases with increasing

local window size. As expected earlier, multispectral band approach produced exceptionally low accuracy. Combination of texture-transformed bands alone generated by lacunarity methods slightly improved the overall classification accuracy. In general, neither multispectral bands nor texture-transformed bands alone provided satisfactory accuracy. Combination of multispectral bands and texture-transformed bands gave the highest overall accuracy. The results from this study suggest that the accuracy of multispectral image analysis for classifying urban features using fine resolution data could be significantly improved with the use of lacunarity based texture transformed images.

9:30 – 9:45 PREDICTING OHV USE LOCATIONS USING REMOTE SENSING AND GIS

Sydney Schoepke (Northern Arizona University, Flagstaff, AZ)

Off Highway Vehicles (OHVs) have quickly moved to the top of the list for controversial recreation activities. Although many public agencies have adopted strategies to track use there is not enough funding available to carefully inventory and monitor OHV activity on all public lands. Beyond lack of funding, another problem with monitoring OHV use is as fast as land managers develop monitoring programs for OHV use, riders push the limits of their machines and access new locations. In order to mitigate these problems, land managers need to explore new techniques to effectively and efficiently monitor and predict OHV use locations. One of the best methodologies could be using technology already mainstream in many agency offices: aerial photography (remote sensing) and Geographic Information Systems (GIS). The purpose of this study is to determine if remote sensing, geographic information systems (GIS) and field analysis can efficiently and effectively predict OHV use areas. The estimated completion date for this study will be August, 2007. Therefore, this presentation will be designed as a progress report to explain methodologies and results as of the date of presentation.

9:45 – 10:00 CHARACTERIZING THE SPATIAL STRUCTURE OF ENDANGERED SPECIES HABITAT USING GEOSTATISTICAL ANALYSIS OF IKONOS IMAGERY

Cynthia S.A. Wallace[1] and Stuart E. Marsh[2] ([1] U.S. Geological Survey, Tucson, AZ
[2] Arizona Remote Sensing Center, University of Arizona, Tucson, AZ)

Our study used geostatistics to extract measures that characterize the spatial structure of vegetated landscapes from satellite imagery. These measures were used to map endangered Sonoran pronghorn habitat for a study site in southwestern Arizona on the Cabeza Prieta Wildlife Refuge. Fine spatial resolution IKONOS data provided information at the scale of

individual trees or shrubs that permitted analysis of vegetation structure and pattern. We derived images of landscape structure by calculating local estimates of the nugget, sill, and range variogram parameters within 25x25-meter image windows. Previous studies have shown that these variogram parameters, which describe the spatial autocorrelation of the 1-meter image pixels, can discriminate between different species-specific vegetation associations. By coupling the derived measures with Sonoran pronghorn sighting data, we constructed two independent models of pronghorn landscape preference: a distribution-based model and a cluster-based model. The distribution-based model used the descriptive statistics for variogram measures at pronghorn sightings, whereas the cluster-based model used the distribution of pronghorn sightings within clusters of an unsupervised classification of derived images. Both models define similar landscapes, and both effectively predict the locations of an independent set of pronghorn sightings. Such information, although not a substitute for field-based knowledge of the landscape and associated ecological processes, can provide valuable reconnaissance information to guide natural-resource management efforts.

10:00 – 10:30 COFFEE BREAK: FOYER

11:30 – 1:40 LUNCHEON: PEAKS ROOM IN DU BOIS CONFERENCE CENTER

GEOLOGY SECTION

SESSION I 8:00

ROOM: 135

Chairperson: Robert McCord

8:00 – 8:20 *TWO SIGNIFICANT NEW LATE TRIASSIC FOSSIL LOCALITIES FROM PETRIFIED FOREST NATIONAL PARK, ARIZONA

William G. Parker (Petrified Forest National Park, Petrified Forest, AZ), Sterling J. Nesbitt (American Museum of Natural History, New York, NY), Randall B. Irmis (University of California Museum of Paleontology, Berkeley, CA), Michelle R. Stocker (University of Iowa, Iowa City, IA) and Matthew A. Brown (Petrified Forest National Park, Petrified Forest, AZ)

A recent paleontological inventory of Petrified Forest National Park in northeastern Arizona has resulted in the discovery of two new significant fossil localities. The two localities are in a bluish-grey horizon in the Petrified Forest Member of the Upper Triassic Chinle Formation. Both localities are 15 meters below the radiometrically dated Black Forest bed, indicating they are Norian in age. The first locality, The Giving Site, is significant because its diversity of fossil vertebrates, including at least eight specimens of theropod and basal saurischian dinosaurs, which are very rare in the Chinle Formation. Taxa from the Giving Site include the aetosaur *Typothorax coccinarum*, *Postosuchus*, a shuvosaurid, and the basal saurischian dinosaur *Chindesaurus bryansmalli*. The second locality, the *Revueltosaurus* Quarry, is significant because of the preservation of numerous skeletons of the crocodile-line archosaur *Revueltosaurus callenderi*, both as associated skeletons and isolated individual elements. Until the discovery of this locality, *Revueltosaurus* was only known from isolated teeth and considered to represent an ornithischian dinosaur. Thus the discovery of these two localities has important implications for the Late Triassic fossil record and the origin and distribution of early dinosaurs.

8:20 – 8:40 *PRELIMINARY DESCRIPTION OF FOSSIL FELIDAE (MAMMALIA; CARNIVORA) FROM THE ST. DAVID FORMATION, (BLANCAN) SOUTHEASTERN ARIZONA

John-Paul Hodnett (Northern Arizona University, Flagstaff, AZ)

A review of the felid (Mammalia, Carnivora, Felidae) fossils from the St. David Formation near Benson and St. David, Arizona, (Blancan Land Mammal Age; 5.0-2.0 Ma) has yielded an expanded and diverse cat fauna from two localities within the stratigraphic sequence. Previous faunal accounts listed only two cat species; *Panthera* cf. *onca* (jaguar) and "*Felis"* sp. (small cat). New studies on known published materials from the Smithsonian Institution and University of Arizona and new undescribed fossils from the American Museum of Natural History have raised the previous number of cat species from two to five. In my research, these species are: *Smilodon* cf. *gracilis* (saber-tooth cat), *Miracinonyx* cf. *inexpectatus* (cheetah-like cat), *Puma lacustris* (small puma-like cat), *Lynx* sp. (ancestral bobcat), and an unidentified felid species. According to my studies, the record of *Panthera* cf. *onca* is removed from the St. David Formation faunal list after re-examining material referred to this species. My analysis indicates that this material represents two separate species: the hyaena *Chasmaporthetes ossifragus* and *Miracinonyx* cf. *inexpectatus*. The St. David Formation fossils of *Smilodon* cf. *gracilis*, *Miracinonyx* cf. *inexpectatus*, and *Lynx* sp. represent some of the oldest records for these species in North America.

8:40 – 9:00 BLANCAN NALMA TURTLES AND TORTOISES FROM THE GILA CONGLOMERATE, 111 RANCH AREA, GRAHAM COUNTY, ARIZONA

Robert D. McCord (Mesa Southwest Museum, Mesa, AZ)

Numerous fossil turtles and tortoises have been recovered from surface collecting in the 111 ranch beds, Gila Conglomerate, Graham County, Arizona. These deposits are Blancan NALMA, approximately 2.4 MYBP. Fossil *Kinosternon,* where material has been adequate, are all referable to *K. arizonense.* a previous report of *K.* cf. *K. sonoriense,* as well as the relationship of fossil *K. arizonense* (which includes the type) to modern supposed conspecifics, merits reexamination. Fossil box turtles are referable to *Terrapene ornata longinsulae.* Fossil *Gopherus* include numerous specimens of a turtle clearly belonging to the *Gopherus (Gopherus)* clade, and not belonging to either extant species. Continued preparation of excellent material makes further comment on this taxon's relationship premature. The discovery of a caudal buckler confirms that at least some of the *Hesperotestudo* specimens are referable to *Hesperotestudo* (*Hesperotestudo*).

9:00 – 9:20 PRELIMINARY ANALYSIS OF NEW GOMPHOTHERIID (PROBOSCIDEA, MAMMALIA) MATERIAL FROM CENTRAL AND SOUTHEAST ARIZONA

Michael R. Pasenko, Flagstaff, AZ

A partial cranium from the Castle Hot Springs area, Yavapai County and a manus and pes from 111 Ranch, Graham County, Arizona are first described. The partial cranium displays characters indicating it is more derived than the earliest gomphotheriid *Gomphotherium*.

Based on the position and orientation of the premaxilla, maxilla, zygomatic process, and tusk alveoli the cranium can be assigned to *Stegomastodon* sp. This cranium represents a young adult with M1s and M2s in place. A recently recovered manus and pes from the late Pliocene 111 Ranch is here initially assigned to the family Gomphotheriidae . *Rhynchotherium* and *Stegomastodon* are the only proboscideans documented from 111 Ranch. Further studies of the manus and pes should allow assignment at the generic level. This manus and pes includes complete phalanges rarely recovered or studied in extinct proboscideans. The manus and pes are compared to those of published documents of *Mammuthus*, *Mammut*, *Gomphotherium*, *Rhynchotherium*, and *Stegomastodon*. Early comparisons illustrate differences between the 111 Ranch material and the genera *Mammuthus* and *Mammut*.

9:20 – 9:40 AN ANALYSIS OF NORTH AMERICAN *MARTES* (CARNIVORA: MUSTLIDAE) CRANIA USING GEOMETRIC MORPHOMETRICS AND ITS IMPLICATIONS FOR THE STATUS OF THE EXTINCT TAXON *MARTES NOBILIS*.

Jeffrey I. Meyers (Northern Arizona University, Flagstaff, AZ)

First described by Hall in 1926, the taxon *Martes nobilis* (*M. caurina nobilis*), a Pleistocene variant of the North American pine marten, was initially recognized from specimens recovered from caves in Shasta County, California. Hall differentiated *M. nobilis* from the extant pine marten, *M. americana*, largely through qualitative observations based on the size divergence between the modern and extinct taxa. In this investigation of modern and fossil taxa, geometric morphometric (GM) techniques, in addition to statistical and ordination analyses, were brought to bear on the issue of the binomial validity of *M. nobilis*. Using these techniques, a comprehensive examination of the cranial morphology variance of *Martes* was undertaken. Present data indicate that the use of geometric morphometrics can accurately distinguish members of the genus *Martes*, even at the subspecies level. A canonical variate analysis (CVA) was applied to the partial warp scores obtained from the basicrania of 12 different modern and fossil subspecies of *Martes*. The program was able to correctly identify these crania (n=153) to subspecies with nearly 100% accuracy. These analyses suggest that subspecific and specific divisions of the genus *Martes* can be accurately discerned using GM. As a result, it can be determined whether specimens of *M. nobilis* fall within the range of variance of modern North American *Martes*, independent of linear body size.

9:40 – 10:00 MAMMALIAN FAUNA OF HERRING PARK CAVE, SOUTH PARK, CENTRAL COLORADO

Victoria Black (Northern Arizona University, Flagstaff, AZ)

Herring Park Cave is a small overhang located in the Mosquito Range, bordering the southwestern edge of South Park, central Colorado. The surrounding area today consists of montane grasslands and forests with Ponderosa and bristlecone pine. Remains from the deposit include modern *Bison*, which have been extirpated from the area since the 1880s. Other remains consist of rodents, including *Neotoma*, *MicrotusPeromyscus*/*Reithrodontomys*, and several species of Sciuridae. A *Lemmiscus curtatus* molar shows a morphology believed to have been extinct since the late Pleistocene or early Holocene. Lagomorphs and small carnivores are also present. A charcoal layer taken from near the bottom of the excavation was radiocarbon dated at 1930±60 years BP, placing the deposit during the late Holocene. Site taphonomy is complex, with at least two taphonomic agents depositing bone at the site: (1) *Neotoma* and (2) raptor. This study provides the first baseline examination of a late Holocene faunal community in central Colorado.

10:00 – 10:30 COFFEE BREAK: FOYER

10:30 – 10:50 WUPATKI NATIONAL MONUMENT PACKRAT MIDDEN SERIES: A 17,000 YEAR RECORD OF VEGETATION CHANGE

Kirsten E. Ironside (Northern Arizona University, Flagstaff, AZ), Kenneth L. Cole (USGS Southwest Biological Research Center, Flagstaff, AZ) and Scott R. Anderson (Northern Arizona University, Flagstaff, AZ)

Twenty-one packrat (*Neotoma*) middens were collected at Wupakti National Monument, Arizona. The middens resulted in a 17,000 calendar year record of vegetation change, caused by shifts in climate and disturbance. Wupatki National Monument is located on the southern Colorado Plateau and is dominated by grasslands in the western portion of the Monument and desert shrubs in the east. Midden plant macrofossils dated to the late Pleistocene show the area was occupied by a cold desert sagebrush steppe before 14,000 year ago. The dominant plant species were *Artemisia tridentata*, cf. *Ericameria nauseousa*, and *Chamaebatiaria millefolium*, with frequent *Juniperus scopulorum* and *Tetradymia canescens*. As the Pleistocene ended, between 14,000 and 13,000 calendar years before present, woodland species such as *Pinus edulis* and *Juniperus scopulorum* increased along with thermophiles such as *Opuntia* cf. *macrorhiza*. Drastic vegetation change followed this period with the termination of the ice age, changing the vegetation to a shrub-cactus-grass dominated landscape during the middle Holocene. Historic middens record an increase in

shrub species and a disruption of grass species abundance starting approximately around 1800 AD and terminating with modern middens. The modern dominant tree, *Juniperus monosperma*, occurs in the record in the last few hundred years and is only abundant in modern middens.

10:50 – 10:10 HISTORIC INVASION OF 3 NATIONAL PARKS BY WOODLAND VEGETATION.

Owen Davis and John Logan (The University of Arizona, Tucson, AZ), and Ken Cole (USGS Southwest Biological Science Center, Flagstaff, AZ)

We present initial findings on the history of the transition from grasslands to woodlands in National Parks on the Colorado Plateau. We have collected stratigraphic sequences from fissures and rock-shelters in Wupatke, Chaco and Petrified Forest National Monuments. The palynological analysis of fissure sediments has been very productive. Pollen preservation is good, and the sedimentation appears to be uninterrupted, but accumulation rates vary greatly among the fissures and rock-shelters studied. T'Sa Ohnd Cave (Chaco NM), shows a decline in charcoal and increase in disturbance at about 350 ^{14}C years ago, followed by a second charcoal decrease and increase in juniper pollen percentages about 100 years ago. Newspaper Cave shows a gradual decline in charcoal and increase in juniper percentages beginning about 2000^{14}C years ago. Doney Fissure shows a decrease in charcoal, increase in juniper pollen, and dramatic increase in the percentages of the dung fungus *Sporormiella*, about 100 years ago. Four palynological events are of recorded at each site: (1) the increase of disturbance indicators and exotic taxa, (2) the increase of tree and shrubs, (3) the increase in dung fungal spores and (4) the decrease in charcoal percentages. These events are not synchronous at all sites and their timing varies from site to site.

11:10 – 11:30 THE NEXT 2000 YEARS: SIMILAR TO THE EARLY HOLOCENE?

Kenneth L. Cole, (USGS Southwest Biological Science Center, Flagstaff, AZ)

Recent data from the southwest correlate well with global records depicting a rapid temperature increase at end of the Younger Dryas Period. Utah Agave and carbon isotopes from fossil packrat middens from the Grand Canyon suggest that winter temperatures increased by at least 4 □C between ca. 11.7 ka and 11.5 ka. The timing and rate of this rapid warming at the end of the Younger Dryas is indistinguishable to similar increases observed in the better-dated records from Greenland ice cores and Eastern Pacific ocean cores. The rate and magnitude of this warming is also similar to that projected to occur over the next century. Previous studies have noted unusual, anomalous plant communities typifying of the Early Holocene Period immediately following this rapid temperature increase. Packrat midden records had previously suggested that species diversity was lower during this time and plant communities were dominated by such species as: *Acacia greggi, Lycium spp., Fraxinus spp.,* and *Ptelea pallida*. Pollen records from this time also contain higher levels of some weedy species such as Artemisia spp. and Asteraceae. Interpretations of these anomalous assemblages have focused such things as the high levels of summer insolation

during this period. But now that detailed data demonstrate the rapid temperature shifts just prior to this period, a successional perspective on this vegetation change may allow a more robust understanding. If this is the case, similar changes could be expected in the future due to the continuing effects of global warming.

11: 30 – 1:40 LUNCHEON: PEAKS ROOM IN DU BOIS CONFERENCE CENTER

HYDROLOGY SECTION

SESSION I 8:00

ROOM: 17

Chairperson: Robert Lefevre

Session I Moderator: Dan Neary

8:00 – 8:15 * INVESTIGATING THE STATE OF CHEVELON CREEK AND POSSIBLE RESTORATION ALTERNATIVES

Michael Hoenig (Northern Arizona University, Flagstaff, AZ), Aregai Tecle (Northern Arizona University, Flagstaff, AZ), Bob Hart (US Geologic Survey) and Don Bills (US Geologic Survey)

Chevelon Creek is a stream that flows from its headwaters in the Sitgreaves National Forest to the Little Colorado River just east of Winslow, AZ. Hugo Meadows State Wildlife Area is located near the mouth of Chevelon Creek where it converges with the Little Colorado River. The Wildlife Area is operated by Arizona Game and Fish Department and houses many species of big game as well as other species of plants and animals. A database is also maintained by the Arizona Department of Water Resources which archives data on wells in Arizona. This data will be used to estimate any changes to the depth to groundwater in the area. The USGS (Water Resources Division) also maintains a database on surface water, including the streamflow of gages on Chevelon Creek. These sets of data can be used to examine the nature of the problems affecting Chevelon Creek which is fairly representative of streams in rural Northern Arizona. An examination of the exact uses of the water taken from the Chevelon Creek drainage basin will be necessary in order to suggest restoration alternatives. This information is available as part of the Arizona Department of Water Resources database. The nature of the solution to the problems discovered depends on what the data show, however, this paper will examine the success of the Chevelon Creek State Wildlife Area in creating or maintaining a suitable habitat at that site and consider protecting it one alternative.

8:15 - 8:30 *FOREST STRUCTURE AND SURFACE RUNOFF IN THE UPPER LAKE MARY, ARIZONA WATERSHED

Cory A. Miller ,David G. Brewer and W. Wallace Covington (Northern Arizona University, Flagstaff, AZ)

The Upper Lake Mary watershed in northern Arizona is extremely important as the sole surface runoff source of water for the city of Flagstaff, Arizona. Since the arrival of European settlers at the end of the 19th century, this watershed has undergone dramatic changes in terms of forest structure, much like forests throughout Arizona and the Southwest.

Forests have become dense, with corresponding increases in canopy closure, percentage of trees in small diameter and young age classes, and number of trees per hectare. These vegetation changes affect surface runoff amounts according to the water balance equation. This study provides an initial assessment of current forest structure conditions on the Upper Lake Mary watershed, which are contrasted with historic forest structure conditions. The declines in surface water flows into Upper Lake Mary and the percentage of surface flow decrease attributable to changes in forest structure are presented.

8:30 – 8:45 EXTRAPOLATION OF THE RESULTS FROM WATER YIELD IMPROVEMENT STUDIES ON UPLAND WATERSHEDS TO LARGER RIVER BASINS

Peter F. Ffolliott (University of Arizona, Tucson, AZ)

Extrapolation of the results from water yield improvement studies on experimental watersheds to larger river basins and ultimately to downstream points of water use requires a series of sequential steps. Experimental watersheds from which the results are extrapolated must be appropriately characterized in terms of the climatic, physiographic, vegetative, institutional, social, economic, and other relevant conditions encountered on the watersheds. The treatable areas within the larger river basins that are not constrained by these conditions are then spatially identified and evaluated relative to implementing the results of the water yield improvement studies. Estimates of the increases in water yield improvement obtained on the treatable areas are routed to downstream points of use in the temporal context of delivering to these points. While these general steps have been presented earlier, the available knowledge on the potential for water yield improvement is more comprehensive at this time and the methodologies required to implement the process are currently more sophisticated. The updated methodology for this extrapolation process is presented in this paper.

8:45 - 9:00 *HILLSLOPE EROSION RATES IN THE OAK SAVANNAS OF THE SOUTHWESTERN BORDERLANDS REGION

Aaron T. Kauffman, Cody L. Stropki, Peter F. Ffolliott (University of Arizona, Tucson, AZ), and Gerald J. Gottfried (US Forest Service, Phoenix, AZ)

Hillslope erosion rates have been measured since May of 2004 on twelve small watersheds located on the eastern slope of Peloncillo Mountains in southwestern New Mexico. Taken together these watersheds, called the Cascabel watersheds, total 451.3 acres. They are situated at elevations between 5380 and 5590 feet, with about 23.4 inches of annual precipitation occurring in a bimodal winter-summer pattern. Measurements of hillslope erosion rates were obtained twice a year, following the winter rainfall season and after the summer monsoons. They provide a measure of hillslope erosion in "naturally-occurring" oak savannas. Comparable measurements of hillslope erosion rates will be made after the anticipated prescribed burning treatments to be applied on the watersheds. The pre- and post-fire hillslope erosion rates will furnish a framework to evaluate the impacts of the

burning treatments on soil erosion and, as a consequence, the productivity of these upland sites and adverse off-site effects.

9:00 - 9:15 *COMPARING BEDLOAD CONDITIONS IN THE CASCABEL WATERSHEDS, CORONADO NATIONAL FOREST

Koestner, K.A. (Northern Arizona University, Flagstaff, AZ), Neary, D.G. (U.S. Forest Service, Phoenix, AZ), Gottfried, G.J. (U.S. Forest Service, Phoenix, AZ), Tecle, A. (Northern Arizona University, Flagstaff, AZ)

Oak savannas and woodlands are a significant ecosystem type of the southwestern Borderlands spanning approximately 800,000km^2. Surprisingly, there is little hydrologic data available to aid in the management of these lands. Fire, which was once the most important natural disturbance in this system, has been excluded due to over-grazing and fire suppression practices following European settlement. Prescribed fire is a management technique to restore natural processes within oak savannas by reducing woody species density, increasing herbaceous plant production, and creating vegetative mosaics on the landscape. However, questions concerning the seasonality of burn treatments and the overall effects of these treatments on hydrologic processes need to be addressed prior to broad management application. A collaborative multi-agency watershed-level study was undertaken in 2000 to evaluate the effects of prescribed burning on this dominant ecotype. Twelve small watersheds were established on the eastern side of the Peloncillo Mountains of southwestern New Mexico to evaluate the hydrologic and ecological impacts of cool and warm season prescribed burning. The data gathered between 2000 and 2006 provide calibration data prior to proposed 2007 treatments. This paper is a pretreatment analysis comparing channel cross-sections of two watersheds situated at the higher elevations of the study area to two watersheds at the lower elevations of the study area. The bedload condition information presented in this paper will provide data that will aid in deciding treatment locations and provide insight into the factors causing variation in the hydrology of oak-savanna watersheds.

9:15 – 9:30 HYDROLOGY OF SOUTHWESTERN OAK ECOSYSTEMS: A REVIEW

Gerald J. Gottfried (U.S. Forest Service, Phoenix, AZ), Peter F. Ffolliott (University of Arizona, Tucson, AZ), and Daniel G. Neary (U.S. Forest Service, Flagstaff, AZ)

Information about the hydrology of oak ecosystems of the southwestern United States and northern Mexico is lacking, even though the woodlands and savannas cover more than 31,000 square miles. These ecosystems generally are found between 4,000 and 7,300 ft in elevation. Precipitation occurs in the winter and summer, and averages between 15 and 20 inches annually. The lands are important for rangelands for livestock, wood products, wildlife habitats, and public recreation. Hydrologic information is important to public and private land managers for planning and assessing the impacts of activities. This includes forest land management plans, landscape fire plans, and other NEPA activities. Water yield

augmentation by vegetation manipulations is not feasibility in most locations because of high evapotranspiration, but the impacts of past and present management on erosion and sedimentation are a major concern. While anecdotal information exists, formal research data are uncommon. Hydrological research has been initiated in the oak ecosystems of Arizona and New Mexico. Much of the work has been concentrated in the San Rafael Valley of southern Arizona and on the Cascabel Watersheds of western New Mexico. The paper reviews recent published research on segments of the hydrologic cycle including interception, oak water use, runoff, and sedimentation.

9:30 – 9:45 *SPATIO-TEMPORAL MULTI-OBJECTIVE DECISION MAKING IN FOREST WATERSHED MANAGEMENT

Boris Poff (Rocky Mountain Research Station, Flagstaff, AZ), Aregai Tecle (Northern Arizona University, Flagstaff, AZ), Daniel G. Neary (Rocky Mountain Research Station, Flagstaff, AZ), Brian Geils (Rocky Mountain Research Station, Flagstaff, AZ), and Ruihong Huang (Northern Arizona University, Flagstaff, AZ)

Forest and their watersheds are unique ecosystems providing numerous social and ecological services. The management of such systems involves multiple interests and stakeholders with different, often conflicting expectations and management objectives. Today's ecosystems require the ability to accommodate commercial as well as non-commercial objectives, both quantitative and qualitative, and respond to social, political, economic as well as cultural changes. These objectives have to be applied to changing ecosystems, across landscapes. This calls for Multi-Objective Decision Making (MODM) in a spatial as well as temporal context. With the forest planning software available to us today and considering the complexity and number of variables involved in ecosystem management it makes sense to use a spatio-temporal MODM framework. This paper deals with MODM forest watershed management in spatial and dynamic computer programs with a MODM technique. Using multiple forest management objectives the authors present how such a MODM technique can conceptually be used to find solutions to a dynamic forest ecosystem management problem on a watershed scale. This study identifies forest management alternatives expressed in terms of changes in forest overstory vegetation density in the pondersa pine forest in the northern Arizona

9:45 – 10:00 *IMPACTS OF UPLAND WATERSHED DISTURBANCES ON RIPARIAN ECOSYSTEMS

Peter F. Ffolliott and Cody L. Stropki (University of Arizona, Tucson, AZ)

Soil erosion and the resulting sediment movement and surface runoff (overland flow) are crucial to the stability of riparian ecosystems. In essence, soil erosion on the surrounding upland watersheds and sediment transport and water flow through the downstream riparian areas are controlled by the vegetation, topography, hydrology, and soil and geologic formations within this linked system. A response to disturbances on the upland watersheds such as fire, livestock grazing, or tree cutting on the quantity and quality of streamflow, bank

storage, and channel stability of the riparian corridors must be determined within this context. This paper stresses the key relationships between watershed condition and riparian health and how these relationships can change as a consequence of watershed disturbances in terms of a dynamic equilibrium between channel erosion (degradation) and sediment deposition (aggradation). Management implications of these relationships are also discussed.

10:00-10:30 **COFFEE BREAK: FOYER**

Session II Moderator: Robert Lefevre

10:30 – 10:45 *DEBRIS FLOW GENERATION IN ADJACENT UNBURNED AND RECENTLY-BURNED AREAS, CORONADO NATIONAL MEMORIAL, ARIZONA

Ann Youberg (University of Arizona, Arizona Geological Survey, Tucson, AZ),
Victor R. Baker (University of Arizona, Tucson, AZ),
Philip A. Pearthree (Arizona Geological Survey, Tucson, AZ)

Southeastern Arizona experienced an extremely wet interval near the end of July 2006 that generated floods of record and numerous debris flows in some of the mountain ranges of this region. Intense precipitation in Coronado National Memorial near the international border with Mexico generated approximately 66 debris flows in steep mountain drainages. Coronado National Memorial encompasses 1924 ha, of which approximately 135 ha were burned by a wildfire in May, 2006. Debris flows of various sizes, some with deposits up to 3 m thick, were generated in both unburned and recently-burned areas. Although extreme precipitation was the cause of debris flow generation, the presence of debris flows in both unburned and burned areas provides an opportunity to evaluate the influence of wildfires on debris-flow initiation mechanisms and volumes. We mapped each debris flow, identified probable initiation mechanisms, and surveyed selected debris-flow channels to estimate debris-flow volumes. Preliminary observations suggest that debris flows in burned areas initiated by intense runoff and failures in multiple small hillslope rills, whereas most debris flows in unburned areas initiated as either discrete shallow failures of colluvium over bedrock or failures of channel sediment by intense runoff over bedrock cliffs.

10:45 – 11:00 *SOUTHWEST GARDENS: MATCHING PLANTS WITH AVAILABLE WATER RESOURCES

Jolie A. Goldenetz (University of Arizona, Tucson, AZ)

Home and community gardens provide many ecological services including food provision, scenic landscape, and wildlife habitat. In areas where annual precipitation is comparatively low and sporadic, garden design and choice of vegetation are important considerations. This paper gives a brief review of seeds suppliers, water-harvesting techniques, and landscape designs relevant for Southwest gardens. The aim of this review is to help gardeners use their available resources in an ecologically sustainable manner.

11:00 – 11:30 HYDROLOGY SECTION BUSINESS MEETING

11:30 - 1:40 LUNCHEON: PEAKS ROOM IN DU BOIS CONFERENCE CENTER

Session III Moderator: Gerald Gottfried

1:45 – 2:00 THE ECOLOGICAL NICHE OF THE CORONADO NATIONAL FOREST FOR WATER RESOURCES

Robert E. Lefevre (Coronado National Forest, Tucson, Arizona) and Kevin Halverson (Southwestern Region Forest Service, Albuquerque, NM)

The Coronado National Forest is made up of a group of mountain ranges known as the Sky Islands in Southeastern Arizona. These mountain ranges provide an interesting function for the water resources of the area. Water yields from the Forest are larger per land unit area than adjacent lands, there are more miles of perennial streams per unit area for most watersheds on the Forest than off, and riparian resources are of a different composition and structure.

2:00 – 2:15 HYDROLOGY AND INVASIVE FISH MANAGEMENT IN THE SOUTHWESTERN UNITED STATES: GOING WITH THE FLOW

John N. Rinne (Rocky Mountain Research Station, Flagstaff AZ)

More than a hundred species of nonnative, invasive fishes have been introduced into the waters of Arizona and the Southwestern United States. Most were sportfishes introduced into many of the reservoirs that were constructed with inception of the Reclamation Act of 1902. Ultimately many species were transported into streams and rivers naturally by peak flow regimes and artificially by human introductions. As a result, most of the native fish species became much reduced in range and numbers and ultimately were listed as threatened and endangered species. Since the 1973 Endangered Species Act, much effort has been directed toward sustaining and enhancing native species. Research and monitoring have demonstrated that flow regimes or hydrographs have a direct and often marked impact on fish assemblages. The presentation will present and discuss: 1) the extent of introductions, 2) changes in fish assemblages in waters in the Southwest, and 3) the influence of hydrographs on both native and nonnative fishes. Ultimately, the importance of hydrographs for sustainability of native fishes will be demonstrated.

2:15 – 2:30 ROLE OF WILDFIRE IN DESERTIFICATION AND WATERSHED DEGREDATION

Daniel G. Neary (Rocky Mountain Research Station, Flagstaff, AZ)

Wildfire is a natural phenomenon that began with the development of terrestrial vegetation in a lightning-filled atmosphere. It is a global-scale phenomenon that shows itself in Carboniferous period sediments from 350 million years ago. As human populations developed in the Pleistocene and Holocene epochs, mankind transformed fire into one of its oldest tools. Humans are now the primary source of forest and grass fire ignitions throughout the world. As human populations have increased and industrialized in the past two centuries, fire ignitions and burned areas have increased due to both sheer numbers of people and anthropogenic changes in the global climate. Recent scientific findings have bolstered the hypothesis that climate change is resulting in fire seasons starting earlier, lasting longer, burning greater areas, and being more severe. A negative impact of prime concern in the 21st Century is desertification. This term refers to land and watershed degradation, not the immediate creation of classical deserts. It is about the loss of the land's proper hydrologic function and biological productivity as a result of human activities and climate change. It affects one third of the earth's surface and over a billion people. . In the past it was considered a problem of only arid, semi-arid, and dry sub-humid areas. However, humid zones can undergo desertification with the wrong combination of human impacts. Fire-related desertification has consequences in terms of environmental, social, and economic costs. Some of the environmental consequences are vegetation destruction, plant species and type shifts, exotic plant invasions, wildlife habitat destruction, soil erosion, floods, watershed function decline, water supply disruption, and air pollution. Some of these consequences are short-term and others operate over longer periods. This paper discusses potentially devastating impacts and consequences of wildfires and improper prescribed fires that lead to desertification

2:30 – 2:45 MODELING PRECIPITATION-RUNOFF RELATIONSHIPS FOR WATER YIELD FROM ARIZONA'S FORESTED WATERSHEDS

Aregai Tecle (Northern Arizona University, Flagstaff, AZ) and Assefa Desta (a former graduate student Northern Arizona University, Flagstaff, AZ)

This paper is concerned with modeling precipitation-runoff relationships for water yield from a forested watershed in Arizona. The watershed is Bar M watershed, the largest of the former Beaver Creek Experimental watersheds. It is located in north-central Arizona about 42 km south of Flagstaff and has an area of 6,678 ha. Surface runoff is estimated using a water balance approach that accounts for all important hydrological processes such as precipitation, canopy interception, evaporation, transpiration, snow accumulation and melt, infiltration, and soil water storage. A geographic information system (GIS) is used to develop layers of watershed characteristics such as elevation, slope, aspect, canopy cover, and soil type to

divide the watershed into semi-homogenous 90 by 90 m cells. The estimated surface runoff is routed from cell to cell in the direction of flow resulting in the estimated total surface runoff at the outlet of the watershed. The estimated water yield from the watershed for cold-season is 105 mm, which is 22 percent of the total seasonal precipitation while that for the warm-season is 4.3 mm, which is 1.9 percent of the total seasonal precipitation. However, the amount of water yield in both seasons varies in due to spatial variation in landscape characteristics such as latitude, longitude, elevation, and aspect.

3:00 - 3:30 COFFEE BREAK: FOYER

MATHEMATICS/PSYCHOLOGY/SCIENCE EDUCATION SECTION

SESSION I 8:30

ROOM: 34

Chairpersons: Shafiu Jibrin, Melinda Davis, Pedro Chavez

8:30 – 8:45 FINDING EXTREME OUTLIERS IN MULTIVARIATE DATA SET

Ryan Sharp (Northern Arizona University, Flagstaff, AZ)

This talk presents a probabilistic algorithm for finding extreme outliers in large multivariate data set. The algorithm is based on the semidefinite coordinate directions algorithm for identifying necessary constraints in semidefinite programming. It has a preprocessing step that reduces the size of the data before the outliers are found. We show the application of the method to data obtained from NASA.

8:45 – 9:00 MODIFIED HARDY-WEINBERG EQUILIBRIUM

Nathan Leonard (Northern Arizona University, Flagstaff, AZ)

Hardy-Weinberg equilibrium, p^2+2pq+q^2=1, is a formula that takes the genetic distribution of a population and determines what it will be in the next generation if there are no evolutionary forces. This formula is handy but inherently flawed. When working with the forces of nature, it is necessary to abide by the laws of nature. In its current configuration, Hardy-Weinberg allows for clones and beings with only half their DNA. Modified Hardy-Weinberg removes these anomalies.

9:00 – 9:15 ESTIMATING DISEASE SEVERITY IN MUSCULAR DYSTROPHY

Melinda F. Davis (University of Arizona, Tucson, AZ)

Numerous measures of functioning and impairment for muscular dystrophy (MD) exist; however, the scores on these measures are not uniform or directly comparable. There is disagreement over which measure is best and whether to assess impairment or function. Existing measures are often ordinal and the distance between each step on a scale is not known. Scores on existing measures do not indicate approaching need for care and often do not allow for missing data. This presentation proposes a scale of disease severity that can be estimated from data available in an individual's medical chart, is independent of the tests and

instruments used, is robust to missing data, and can be used to measure treatment outcomes. Such a measure will be composed of sentinel events that are indicators of disease severity and will be present in an individual's medical chart. Examples include serial casting, surgical tendon release, use of walker, long-leg braces, wheelchair use, fractures, non-invasive ventilation, tracheostomy, and the use of mechanical ventilation. Rasch modeling can be used to place each item (in these cases sentinel events) in a scale, estimate the distance between each indicator in equivalent intervals, and evaluate the fit of each indicator to the model. Rasch modeling does not require all indicators to estimate disease severity or progression.

9:15 – 9:30 * PERFORMANCE IMPROVEMENT IN THE CLASSROOM: EFFECTIVE STRATEGIES FOR SCIENCE TEACHERS

Debbora Woods-Schmitt (Grand Canyon University, Phoenix, AZ) and William Perry Baker (Midwestern University, Glendale, AZ)

Student achievement requires mastery of both content and critical thinking. Yet, a substantial percentage of students have failed to acquire critical thinking skills by the time they become college undergraduates. Students who are not yet critical thinkers remain excluded from full mastery of important course content. Given the diversity of critical thinking skills and the complex demands of science instruction, clearly what is needed is instruction that makes critical thinking skills accessible to all learners. Learn effective Performance Improvement (PI) strategies to create a learning environment that promotes content competency and critical reasoning skills. Rubrics and formative assessments included.

9:30 – 9:45 * LEARNING AND TRANSFERENCE IN DIVERSE LEARNING ENVIRONMENTS

Debbora Woods-Schmitt (Grand Canyon University, Phoenix, AZ) and William Perry Baker (Midwestern University, Glendale, AZ)

Research has shown that Performance Improvement (PI) strategies are the best way to increase learning and transference in diverse learning communities. Explore the latest tips, tools, and techniques to increase student performance in undergraduate science classrooms. Learn strategies to provide students with the opportunity to gain content competency and acquire critical reasoning skills. Discuss exercises that emphasize conceptual understanding and exploratory activities guided by the scientific method. The authors have found significant gains in student achievement using these activities in an inclusive learning environment. Equally valuable to academics involved in classroom, distance, and electronic learning.

9:45 – 10:00 ETHICAL IMPLICATIONS OF HUMAN GENOME DATA: THE GENOME BIOBANK

Carleton B. Jones and William Perry Baker (Midwestern University, Glendale, AZ)

Understanding human genetics is an important part of the standards-based science curriculum. In our experience, however, the topic is a difficult one for many students. Learn strategies to effectively incorporate new human genome information into your classroom science activities. Examine issues surrounding genetic databanks and population genetics studies. Students investigate methods of collecting human genome information and evaluate web sites of various Biobanks. Then they work in groups to invent a Biobank of their own that they write about and illustrate. Complete materials, rubrics and formative assessments included.

10:00 – 10:30 COFFEE BREAK: FOYER

11:30 - 1:40 LUNCHEON: PEAKS ROOM IN DU BOIS CONFERENCE CENTER

POSTER SESSION

SESSION I 10:00 – 10:30

ROOM: FOYER

Chairperson: Robert Reavis

*PROBING FOR FLEXIBLE REGIONS OF THE p53 DNA BINDING DOMAIN THROUGH MASS SPECTROMETRY

Casey Goodyear and Matthew J. Gage (Northern Arizona University, Flagstaff, AZ)

The tumor suppressor protein p53 is known as "the guardian of the genome" due to its ability to induce either DNA repair or apoptosis when genetic damage occurs. In over 50% of tumors, p53 itself contains mutations and does not function properly and in some cases, these mutations are known to cause the protein to aggregate. Protein aggregation is often caused by a structural change in the protein. A previous study has shown that addition of up to 1M urea reduces aggregation of the DNA binding domain (DBD) of p53. This suggests that a flexible region of the protein is responsible for aggregation. We are testing this hypothesis using a combination of limited proteolysis and hydrogen/deuterium exchange. These results will provide insight into the regions of p53 responsible for aggregation.

*THE C_TERMINUS OF P22 TAILSPIKE PROTEIN INDUCES OLIGOMER IZATION OF THE MALTOSE-BINDING PROTEIN

Justin Saul, Sarsati Gurung, Trenton Baker, and Matthew J. Gage (Northern Arizona University, Flagstaff, AZ)

The P22 tailspike protein is a well-established model system for studying folding and assembly of oligomeric proteins and numerous studies have documented both in vivo and in vitro folding intermediates. Previous results have demonstrated that the C-terminus in the tailspike protein is critical for both assembly of the protrimer intermediate and for maturation of the protrimer to the final trimer. This poster demonstrates how the placement of the TSP C-terminus onto the monomeric maltose binding protein (MBP) results in oligomerization of MBP that does not occur in the native MBP protein. Western blotting studies using an anti-TSP antibody demonstrate that the C-terminus in this chimera is in the same conformation as in the native TSP protein, though chromatography studies indicate that the MBP-537 chimera has four subunits associated together in contrast to the three that associate in TSP. The oligomerization of the MBP-537 chimera is promoted by hydrophobic interactions, similar to the native tailspike protein and follows a similar refolding sequence, albeit with apparently altered kinetics. These results further support the importance of the C-terminus of TSP in assembly of the mature trimer and demonstrate the potential utility of this system for isolated study of the association events involving the C-terminus of TSP during refolding.

NEW CYATHASPIDIDS (HETEROSTRACANS: AGNATHA) FROM THE EARLY DEVONIAN OF EASTERN NEVADA

David Elliott, Lisbeth Carmona, and Joshua Schell (Northern Arizona University, Flagstaff, AZ)

Heterostracans were a widespread group of armored agnathans that are particularly associated with proximal marine environments of the Old Red Sandstone continent. A vertebrate fauna from the Early Devonian Sevy Dolomite of eastern Nevada contains an actinolepid arthrodire, acanthodians, and pteraspidid heterostracans all of which have been recently described, however, the three species of cyathaspidid heterostracans have not. Of these one is newly recognized as *Allocryptaspis sandbergi*, a species recently described from the Water Canyon Formation of northern Utah and a second is a new species that also occurs in the Sevy Dolomite in Utah and the Lost Burro Formation in California. The third is a new species of *Ctenaspis* that is unknown elsewhere. Because of the absence of invertebrate faunas there are problems with the correlation of Lower Devonian nonmarine sedimentary rocks in the western United States, resulting in various age assignments. The identification of these cyathaspidids allows a more precise correlation of the three formations and their assignment to the Emsian.

EVALUATION OF BASE-FLOW DISCHARGE IN LOWER CLEAR AND CHEVELON CREEKS, AND THE LITTLE COLORADO RIVER NEAR WINSLOW, ARIZONA, SUMMER 2005 AND 2006

Donald J. Bills (U.S. Geological Survey, Arizona Water Science Center, Flagstaff, AZ)

The U.S. Geological Survey and a team of other federal and private investigators is evaluating the base flow of the lower parts of Clear Creek and Chevelon Creek and the Little Colorado River east of Winslow, Arizona. Ground-water discharge from the C aquifer maintains base flow in these stream reaches. Proposed increases in ground-water withdrawals from the C aquifer in this area have the potential to capture ground water that would otherwise discharge to these streams. Reduced base flow of these streams may threaten riparian habitat, at least one endangered species, and surface-water rights in both drainages.Little is known about the quantity and chemistry of ground-water that provides base flow to the lower reaches of Chevelon and Clear Creeks. On the basis of historic stream-flow data from the mid 1960's and earlier, base flow of these two drainages is about 4 cubic feet per second (ft^3/s) each. More recent measurements (June and July 2005 and June 2006) indicate summer base flow to be about 5.4 and 2.6 ft^3/s for Clear Creek and Chevelon Creek respectively. In both drainages the water quality degrades downstream becoming more saline near the mouths. The Little Colorado River between the mouths of Chevelon and Clear Creeks also was identified as having a base flow component of about 0.5 to 1.0 ft^3/s. The specific conductance increased about 1,000 microsemens per centimeter in this reach indicating that the base flow is derived from the C aquifer and not stream-channel alluvium

*DEPRESSION AND ADHERENCE TO MEDICAL RECOMMENDATIONS IN PATIENTS WITH CORONARY HEART DISEASE

Carrie J. Donoho, Derik W. Stalls, M.A., Sumner J. Sydeman, Ph.D. (Northern Arizona University, Flagstaff, AZ)

Depression has been implicated as an independent risk factor for progression of coronary heart disease in patients who survive acute coronary syndromes such as heart attacks. One line of such research has studied cardiac patients enrolled in Phase II Cardiac Rehabilitation (CR), in which the Beck Depression Inventory (BDI) was used to quantify depression. While depression clearly has a negative impact on cardiac health in these patients, curiously Phase III and Phase IV CR patients have been largely ignored in psychosocial research. One reason appears to be the belief that depression is more of a problem for Phase II patients than patients in Phase III or IV. To remedy this gap, the current study sought to examine whether depression was solely a problem in Phase II CR patients, or whether it was also present for Phase III and Phase IV CR patients. Demographic and clinical data and scores on the BDI were gathered in Phase II, Phase III, and Phase IV CR patients (n = 32). Patients were categorized as Low or High on depression based on BDI scores using a standard cutoff score. Patients were categorized as either Phase II or Phase III/IV. Comparison of depression by CR phase revealed that there was no significant difference in depression in Phase II versus Phase III/IV CR patients ($p = 0.70$). Results of this study suggest that inclusion of Phase III and Phase IV patients is warranted in future studies of depression in CR samples.

INTERRELATION OF CONTINENTAL RIFT FORMATION AND VOLCANISM IN THE BASIN AND RANGE PROVINCE

William L. Cole (Northern Arizona University, Flagstaff, AZ)

The Basin and Range region has been subject to ongoing extensional deformation since middle Miocene time, and several currently active volcanic fields are present within it and adjacent to it. Individual volcanoes in each field tend to be spatially segregated by age, indicating that newly active volcanoes are gradually displaced in a consistent direction over time. This project compares the movements of several volcanic fields, in order to obtain a model that is consistent with the migration of each volcanic field, which will help to explain the history of the Basin and Range province as a whole.Data on the locations and ages of individual volcanoes in the San Francisco, Coso, Southwest Nevada, and Springerville fields consistently show a strong tendency for newer volcanoes to be located further away from the center of the Basin and Range than preceding ones. This behavior is observed throughout Miocene time up to the present. This migration of volcanism over time strongly suggests that volcanism in the Basin and Range is primarily driven by the release of pressure on the asthenosphere caused by the gradual thinning of the crust, and concentrates at the locations of greatest tension at the edges of the expanding Basin and Range region. Overall, the system is consistent with a foreland rift model, and is tectonically similar to other rifts found in central Europe and southeastern Australia.

Ashley Steiner, Jilleen Jones and Matthew J. Gage (Department of Chemistry and Biochemistry, Northern Arizona University, Flagstaff, AZ 86011)

The p53 tumor suppressor protein is one of the most critical points of regulation in tumor prevention. The p53 protein initiates DNA repair or apoptotic pathways in response to DNA damage or other cellular stresses. It comes as no surprise then that more than 50% of all cancers are associated with a mutated form of p53. The effects of p53 aggregation due to mutation on tumor formation are largely unknown. This study will begin to characterize the aggregation propensity of the tetrameric form of p53. We have begun to look at the aggregation rate of a truncated form of the p53 protein, p53-360, which doesnâ€™t have the N- or C- terminus. We have measured aggregation rates with classical light scattering and with the fluorescent probe ThT. We also have begun to characterize the morphology of the aggregates with transmission electron microscopy.

*DISCOVERY OF NOVEL VITAMIN D RECEPTOR INTERACTING PROTEINS (VIPS) INVOLVED IN APOPTOSIS AND BONE MINERAL HOMEOSTASIS

Jana L. Lemau, Pamela A. Marshall, Peter Jurutka (Arizona State University, Phoenix, AZ)

The nuclear vitamin D receptor (VDR) is known to regulate transcription of vitamin D responsive genes involved in bone mineral homeostasis. Runx2, a critical protein required for bone development, and TFIIB, a transcription factor recruited by VDR, have been implicated in bone signaling as VDR interacting proteins (VIPs). We are evaluating the physical interaction between VDR and potential VIPs, including Runx2 and TFIIB, using GST-based interaction assays. These GST pulldown assays demonstrated direct vitamin D-independent binding of VDR with TFIIB and Runx2. We are also utilizing the yeast two hybrid system to discover novel potential VIPs. L40 yeast cells were transformed with a bait (LEXA-VDR) fusion construct and a prey library. Eleven potential VIPs were identified and analyzed by sequence analysis. Clones 5, 6, and 8 were found to be of potential significance. A protein BLAST search of the mammalian database with Clone 6 resulted in a significant match to RANKL, a cell-surface receptor that controls osteoclastogenesis and calcium metabolism. Analysis of clones 5 and 8 revealed apoptosis-inducing TAF9-like domain 1 (APITD1) as a match. Further GST-based interaction assays were performed with VDR, RXR and radiolabeled APITD1. These assays revealed a direct association of VDR and APITD1, with RXR acting as a potential inhibitor of this interaction. TFIIB, Runx2, RANKL, and APITD1 genes were cloned into M2H vectors for further evaluation of VDR interaction in osteoblasts.

MILLTOWN RESERVOIR RESTORATION PROJECT

Sue Rodman (Northern Arizona University, Flagstaff, AZ)

Environmental damage has occurred in most of the Upper Clark Fork River in Western Montana as a result of contaminated wastes originating from historic mining activities in Butte and Anaconda. The mine tailing wastes from these sites flowed down the Clark Fork River and accumulated, along with natural sediment, behind the Milltown Dam seven miles

East of Missoula, Montana. Efforts are currently underway to remove the dam, as well as the contaminated sediment, and return that portion of the Clark Fork River to its historical channel shape, flood plain and wildlife habitat configuration. This paper describes the condition of the degraded environment as well as proposed remedial and restoration plans for the site.

CELL BIOLOGY AND GENETICS LABORATORY MODULES INCORPORATING THE DESERT TREE LIZARD AS A MODEL ORGANISM

Elisabeth Moore, Charles Deutch, Douglas Dennis, Pamela A. Marshall, (Arizona State University – West campus, Glendale, AZ)

The Department of Integrated Natural Sciences at the West campus of Arizona State University has adopted a new curriculum leading to a B.S. degree in the Life Sciences. An innovative feature of this curriculum is the inclusion of experimental work with the desert tree lizard (*Urosaursus ornatus*) in many different courses to link them together thematically. While the experiments in the General Biology course focus primarily on the morphology and behavioral ecology of these organisms, those in the required courses in Fundamentals of Genetics and Cell Biology are designed to introduce students to techniques in modern cell biology. In the laboratory for the Fundamentals of Genetics course, students carry out a two-week project using nondenaturing gel electrophoresis in agarose gels to study the occurrence of allozymes of aconitase hydratase and the NADP-dependent L-malate dehydrogenase in different individuals in captive populations. In the laboratory for the Cell Biology course, students perform a two-week project using SDS-polyacrylamide gel electrophoresis to compare the proteins found in various lizard organs including heart and liver. In both cases, the students gain experience in casting and running gels, in staining and imaging the gels digitally, and in analyzing the images quantitatively. Students in the Genetics lab use their data to determine if the populations are in Hardy-Weinberg equilibrium with Chi-Square analysis while those in the Cell Biology ascertain which proteins appear to be expressed differentially in one tissue or another.

USE OF A THEMATIC ORGANISM TO LINK THE CURRICULUM

Douglas Dennis, Pamela Marshall, and Charles Deutch (Department of Integrated Natural Sciences, ASU – West Campus, Glendale, AZ)

The Integrated Natural Science Department at the West campus of Arizona State University is an undergraduate-focused department comprising the fields of biology, chemistry, physics and geology. In recent years the department has strongly pursued teaching and curricular strategies that demonstrate to students the interconnectedness between disciplines. A vehicle to this end has been the implementation of laboratory modules centered on the desert tree lizard (*Urosaurus ornatus*), an organism familiar to students because it is commonly found in Phoenix and the surrounding area. Modules currently implemented include allozyme analysis in Genetics, tissue-specific protein analysis in Cell Biology, general lizard anatomy and physiology in Introductory Biology, lizard oral flora in Microbiology, respirometry in

Animal Physiology, dominant male behavior in Animal Behavior and a *Urosaurus ornatus* genome project in Molecular Genetics. Modules currently under development include the bases for telemetry and tracking in Physics, uptake and sequestration of selenium in lizard tissue in Analytical Chemistry, and environmental chemical analyses in Introductory Chemistry. The development of the modules has been facilitated by the construction of an outdoor lizard enclosure that allows us to closely mimic the normal habitat of the lizard. The developed laboratory modules will be discussed, as well as expected learning outcomes.

THE *UROSAURUS ORNATUS* GENOME PROJECT AT ASU-WEST CAMPUS

Neha Dixit, Pamela Marshall, Charles Deutch and Douglas Dennis (Department of Integrated Natural Sciences, ASU-West Campus, Glendale, AZ)

The Integrated Natural Science Department at the West campus of Arizona State University is an undergraduate-focused department comprising the fields of biology, chemistry, physics and geology. To strengthen our curriculum the department has designed laboratory modules that focus on various aspects of the tree lizard (*Urosaurus ornatus*). One such project is the *Urosaurus ornatus* Genome Project. This is a 7-week laboratory exercise implemented in our Applied Molecular Biology and Genomics course in which students will be subjected to various aspects of genomics. Initially students will clone random sequences and purify the plasmids on which they are resident. The DNA sequence will be obtained and students will use this sequence to "walk" down the chromosome to obtain additional sequence. It is anticipated that the students will be able to acquire approximately 200,000 bases of sequence information per semester. This raw sequence will be edited and then compiled with existing sequence data. An assembly program will generate contigs and these will be analyzed for putative genes, conserved domains, and other types of sequence similarities. The annotated information will then be uploaded to GenBank. The sequence will also be used to conduct phylogenetic analyses. Since this is the first reptile genome underway, the sequence should be useable by researchers in the field of herpetology.

ACADEMY BUSINESS AND ANNUAL REPORTS

OFFICERS 2007 - 2008

ELECTED

Carlton "Buck" Jones ..... President
Carlton "Buck" Jones ..... President
Elizabeth Hull ..... Recording Secretary
Ingrid Novodvorsky ..... Membership Secretary
Karen Conzelman ..... Treasurer
Michael Diehl ..... Director, Southern Arizona
Robert Reavis ..... Director, Central Arizona
Aregai Tecle ..... Director, Northern Arizona

APPOINTED

William Perry Baker ..... Editor, Journal
Florence Slater ..... Editor, Proceedings
Stephen Williams ..... Science Olympiad/Science Bowl Liaison

SECTION CHAIRS

Robert Bowker ..... Biology
Timothy Vail ..... Chemistry
Steven Yool ..... Geography
Robert McCord ..... Geology
Robert Lefevre ..... Hydrology
Shafiu Jibrin ..... Mathematics
Erik Gergus ..... Poster Session
Melinda Davis ..... Psychology
Pedro Chavez ..... Science Education

COMMITTEE ROSTER

BUD ELLIS SCHOLARSHIP
Stephen M. Shuster

MEMBERSHIP
Ingrid Novodvorsky

OUTSTANDING SCIENCE TEACHER
William Perry Baker

GRANTS-IN-AID
Aregai Tecle

FELLOWS, NOMINATING
Owen Davis

BEST STUDENT PAPER
William Perry Baker

BEST STUDENT POSTER
Erik Gergus

NOMINATING
Owen Davis
William Perry Baker
Buck Jones

NECROLOGY
Ingrid Novodvorsky

PROGRAM
Aregai Tecle

BUDGET
Karen Conzelman

OUTSTANDING SERVICE AWARD
Betsy Cooper
Stephen Williams
Karen Conzelman

PRESIDENT'S REPORT

It has been a year of transition for the Arizona/Nevada Academy of Science. It was a year marked by some significant successes but also by some continuing concerns. We began our calendar with a very successful 50th anniversary meeting that saw a very experienced ANAS President, Peter Ffolliott, hand over the ANAS Presidency to a very inexperienced President-Elect (me). But fortunately, he, Owen Davis, and Perry Baker graciously accepted the roles of advisor and have continued to help me along through the year and I thank them most sincerely for that help. I would also like to thank the rest of our dedicated and talented Board of Governors for their ongoing efforts on behalf of the Academy; they are truly an amazing group of people.

In perhaps the most notable transition during the year, we saw our Journal undergo a significant change, as it became available to a world-wide audience of scientists online as part of the BioOne database. Improving the online accessibility is an exciting and necessary step forward for JANAS as we continue to pursue our mission:

> *"The purpose of this Academy shall be: to stimulate scientific research and education; to disseminate scientific knowledge in the various fields of science; to promote fraternal relationships among those engaged in scientific work; to assist in developing and in making known the material and other resources of these two states; to encourage the publication of reports of scientific investigations; and to unify the scientific interests of the region."*

In continuance of our commitment to disseminate scientific knowledge, in the past year we have been given another great opportunity to make JANAS available online, this time through the JSTOR database, and a motion has been proposed to archive the entire JANAS content, past, present, and into the future.

Other successes of the past year include the continued progress of the 50th Anniversary Book, "Natural Environments of Arizona: Characteristics, Diversity, and Relationships"; continued improvements to the ANAS Website; and now the availability of online payment options for dues, meeting registrations, and other fees.

While it has been an exciting and eventful year, we continue to face some challenges. While we would like to increase membership and participation, rising publication and operating costs may require an increase in member dues. However, I think these are manageable challenges if we focus on meeting the charge of our mission statement. And so, I would like to finish this report with a challenge to all of our existing members: read our mission statement and make a commitment this year to pursuing that mission. Submit a manuscript to the Journal, recruit a new member, educate a student, volunteer for a post on the Board of Governors. The Arizona/Nevada Academy of Sciences has the potential to be anything we would like to make it, but we must each decide to be one of the makers.

Carleton 'Buck' Jones
President

MEMBERSHIP SECRETARY'S REPORT

We currently have a total of 150 members, including 62 non-dues paying members (emeritus or life members). Twelve of our current members are students. Members live in 21 different states in the US and Mexico.

We currently have 36 institutional subscribers, in 15 in the United States and one Canadian province.

Ingrid Novodvorsky
Membership Secretary

NECROLOGY REPORT

There have been no reported deaths of members of the ANAS this year.

Ingrid Novodvorsky
Necrology Secretary

PERMANENT SECRETARY'S REPORT

The regular duties of this office are providing a permanent mailing, phone, and email address for the Academy. It is a great honor for me to serve the Academy in this way. The permanent secretary also provides reports to various governmental and academic societies, and maintains the ANAS archives. The Permanent Secretary provides copies of the Proceedings Volumes and "reprints" from the archived journals and other materials upon request. The Permanent Secretary sends award letters to recipients, and posts the award reports in the Newsletter.

William Perry Baker
Permanent Secretary

OUTSTANDING SERVICE AWARD COMMITTEE

Owen Davis has been active in the Arizona-Nevada Academy of Science for 24 years, and has served the organization unfailingly in numerous positions, including the Geology Section Chair, Fellow Committee Chair, Permanent Secretary, and finally several terms as President. As a member of the Board of Governors, he has been instrumental in moving the Academy into the digital age; he established the ANAS web page, electronic newsletter, listserv, and increased JANAS' accessibility to the global scientific community by making it electronically available through Bio-One. Owen also has taken a keen interest in the history of ANAS, helping to organize its archives and document important events and individuals in its past. When ANAS turned fifty last year, Owen organized an exceptional 50th Anniversary celebration. Highlights included an open-mike dinner with reminiscences of past presidents of ANAS and other founding members, followed by a guided tour of the campus arboretums and the tree ring lab. As newsletter editor, Owen keeps us posted on the goings-on of the organization, and as ANAS Webmaster, he has recently brought us into the 21st century with electronic registration.

After completing his Master's degree in botany at Washington State University, Owen went on to study palynology at University of Minnesota. Dr. Davis returned to the West to join the faculty at the University of Arizona, where he has been a member of the Department of Geosciences for 25 years. His primary research interests have been in the areas of quaternary paleoecology and paleoclimatology, palynology and plant-fossil analysis of lakes, marshes, caves, coprolites, and pack-rat middens. He has served as editor of *Palynology*, has been active in national and international palynology organizations, most recently serving as President and Past-President of the International Federation of Palynological Societies.

Betsy Cooper
Karen Conzelman
Steve Williams
Outstanding Service Committee

OUTSTANDING TEACHER AWARD

The winner for the ANAS 2007 Outstanding Teacher Award competition is:

Johanna Strawser of Desert Heights Charter School, Glendale, Arizona

Congratulations to our winner!

William Perry Baker
Outstanding Teacher Committee

GRANTS-IN-AID COMMITTEE'S REPORT

The winners for the $200 undergraduate grant-in-aid for Fall 2006 are:

Dylan Grippi
University of Arizona, Tucson, AZ (Faculty sponsor: Elizabeth Arnold)
"Phylogenetic diversity of fungal endosymbionts associated with freshwater protista"

Hoang Huynh
Midwestern University, Glendale, AZ (Faculty sponsor: W. Perry Baker)
"Bioactivity of herbal products commonly used in a Mexican-American community"

Michele Hoffman and **Jolie Goldenetz**, who received Graduate Grants in Aid in Fall 2005 and Spring 2006 respectively, recently submitted reports on their ANAS funded research. Links to their two papers, "Molecular analysis reveals a distinctive fungal endophyte community associated with foliage of montane oaks in southeastern Arizona" and "More than a mere newton: Nutrient analysis of heirloom 'Mission' fig tree fruits," can be found at http://www.geo.arizona.edu/anas/awards/

Aregai Tecle
Grants-in-Aid Committee

SCIENCE BOWL/SCIENCE OLYMPIAD LIAISON'S REPORT

The Arizona Science Olympiad and Arizona Regional Science Bowl held their annual tournaments at Glendale Community College (GCC) on March 3, 2007. The 2007 Science Olympiad brought together 20 teams from 16 different Arizona high schools; over 300 high school students competed in events covering a broad spectrum of scientific disciplines, engineering, math and technology. Ribbons and medals were presented to the top seven finishers in each of the 26 different events. In addition, gift certificates, cash prizes or scholarships were awarded to top finishing teams competing in the following events: Boomilever, Chemistry Lab, Circuit Lab, Designer Genes, Energy, Entomology, Food Science, Forensics, Math Applications for Today's Technologies, Remote Sensing, Rocks and Minerals, Scrambler, and Write It-Do It. These awards were endowed by donations from the following sponsors: Arizona Council of Engineering and Scientific Associations, Arizona Science Teachers Association, Bashas', Charles Hoyt, GCC, Intel Corporation, Phelps Dodge Foundation, Salt River Project, Society of Manufacturing Engineers, and Western Area Power Administration. ANAS awarded $1000 in supply money to ten teams that competed in Junkyard Challenge and Sounds of Music. The following Academy members were among the volunteers who helped with the tournament: Robert Bowker, Karen Conzelman, Elizabeth Cooper, Erik Gergus, Robert Reavis, Ryan Sawby, Florence Slater, James Tuohy, and Steve Williams.

At the conclusion of the competition, the top seven ranked teams overall were announced and presented with plaques and trophies. University High School – Black edged out Catalina Foothills High School – Blue by just two points. This Tucson team, their coaches, and Arizona State Director Agripina Paluch will represent Arizona at the national Science Olympiad in Wichita, Kansas in May. Additional information about the Science Olympiad can be found at http://www.gc.maricopa.edu/biology/so

On the same day, 125 students from 13 schools competed in this year's Regional Science Bowl. Chaparral High School won, beating out last year's winner, Phoenix Country Day, 42-40. It was a nail-biter. Scholarships were awarded to the top four schools (3rd - Brophy Preparatory Academy, 4th Desert Vista High School). Chaparral will represent the state at the Department of Energy's National Science Bowl in Washington DC at the end of April. For more information, see http://www.wapa.gov/dsw/scibowl/.

Next year's tournaments will be held at GCC on Saturday, March 1, 2008. If Academy members, their institutions or foundations are interested in getting involved in any capacity, please contact the SO/SB liaison (stephen.williams@gcmail.maricopa.edu).

Steve Williams
Science Olympiad/Science Bowl Liaison

TREASURER'S REPORT
2006

Operating and Short Term Reserve Fund (Vanguard Prime Money Market Fund)

Account Value on 12/31/05	$23,675.10
Dividend Deposits	1,156.11
Account Value on 12/31/06	$24,831.21

Goethe Educational Endowment Fund (Vanguard Index 500 Mutual Fund)

Account Value on 12/31/05	(177.387 shares at $ 114.92/share)		$20,385.31
Transferred Donations	+1.721 shares	Total: 179.108 shares	
Dividends	+2.396 shares	Total: 181.504 shares	
Account Value on 12/31/06	(181.504 shares at $ 130.59/share)		$23,702.61

General Fund

December 31, 2005 Balance	$4,765.65
Transferred to Goethe Educational Endowment Fund	– 115.00
Deposits	+$8,358.07
Expenses	– 6,419.59
Transferred to ASU General Fund	– 2,500.00
December 31, 2006 Balance	$4,089.13

ASU General Fund

December 31, 2005 Balance	($65.28)
Transfer from General Fund	+2,500.00
Expenses	– 1,325.19
December 31, 2006 Balance	1,109.53

Science Olympiad General Fund

December 31, 2005 Balance	$28,915.47
Deposits	+16,044.74
Expenses	– 10,478.67
December 31, 2006 Balance	$34,481.54

Science Bowl General Fund

December 31, 2005 Balance	$1,701.06
Deposits	+4,986.64
Expenses	– 4,231.22
December 31, 2006 Balance	$2,456.48

Market Value of Assets (as of December 31, 2006) **$90,670.50**

General Funds Details

Deposits		Expenses
$8.31	Interest	
1,165.00	ANAS Membership dues	
	Journal:	
1,080.00	Subscriptions	
	Refunds	$30.00
135.00	BioOne Royalties	
676.00	Sale of Back Issues	
1,450.00	Reprints/Page Charges	
	Printing	1,148.08
	Typing	750.00
	Postage	0.00
10.00	Hydrology Proceedings	300.00
	Scholarships	0.00
	Grants-in-Aid, High School:	0.00
	Grants-in-Aid, Graduate	600.00
	Grants-in-Aid, Undergraduate	0.00
	Science Olympiad awards	1,000.00
	Science Olympiad	
11,300.00	Sponsor donations	
4,220.00	Membership dues	1,500.00
107.00	Manuals	607.20
	Tournament	
	Awards and Prizes	1,085.39
	Scholarships	250.00
	Team Travel	2,000.00
	T-shirts	3,895.03
	Supplies	141.66
408.00	Lunches	680.50
	Office Expenses	
4.91	Copying and Postage	114.11
	Bank Charges	30.00
	Outreach	
	Conference registration fees	81.00
	Workshops	69.78
	Travel to Nationals (State Director)	24.00
	Science Bowl	
4,100.00	Sponsor donations	
885.00	School registration fees	510.00
	Scholarships	2,200.00
	Room rental fees	426.99
	Food	723.12
	Supplies	191.11
	Conference registration fees	81.00
	Bank fees	99.00

Deposits		**Expenses**
	Annual Meeting:	
3,500.00	Registration Fees	
225.00	Sponsor donations	
	Proceedings, Printing	512.39
	Proceedings, Postage	86.46
	Coffee Breaks	551.76
	Friday Reception	0.00
	Saturday Luncheon	1,658.57
	Meeting Rooms	0.00
	Awards	
	Outstanding Service	50.00
	Outstanding Teacher	50.00
	Printing/Postage	0.00
	Plaques	41.08
	Best Student Papers	575.00
	Supplies	0.00
115.00	Goethe Endowment Fund Contributions	
	AZ Corporation Commission	10.00
	NAAS Dues	56.30
	Supplies	13.98
	Postage/Office	299.48
	Printing/Office	4.68
0.23	Bank Charges	7.00
$29,389.45	**TOTALS**	**$22,454.67**